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American and Other Machinery Abroad—VI.

[Editorial Correspondence.]

CAST GEARS IN MACHINE TOOLS.

In and about Manchester are a number of shops which have a very wide reputation and wherein excellent work is done. In those which I visited I saw many things which served to throw additional light upon the differences between English and American shop practice. In speaking of these differences, it should be remembered that it is extremely difficult sometimes for a stranger to distinguish between what is the regular practice and simply an isolated or special case. Knowing that this difficulty always confronts the foreigner, and that it has led many of them into very ridiculous mistakes when describing American habits and methods, I have made some special effort to avoid it so far as possible. For instance, I saw a man chipping a good heavy cut off a tooth in the main spindle gear of a new lathe of about 48-inch swing. This lathe was being built in a very famous shop (Whitworth's), the chip was being taken on the non-working side of the tooth, evidently to make it clear in the pinion properly. The gears were all cast, and the lathe was near completion; the wheels being all in place in the headstock, and the latter in its place upon the bed. We all know that this establishment is noted for its splendid work. This practice of chipping gear teeth may be exceptional with them or it may be regular. However that may be, we are bound to believe that there is good reason for it; I speak of it only because, independently of its intrinsic merits as a machine-shop process, it strongly illustrates the difference referred to; for it is certain that no such operation could be seen in an American tool shop.

I have spoken of the fact that the Tangye's have adopted the practice of using cut gears; but this abandonment of cast gears is by no means unanimous among tool builders. On the contrary, some of them stoutly defend cast gears as the best. At Wm. Muir's, in Manchester, they use cast gears, made from iron patterns carefully cut. Mr. Hetherington, who very graciously showed me about the establishment, called my attention to several sets of gears running on lathes and other machine tools of their own make, which were certainly running very smoothly and quietly; more so than some cut gears I have seen on our own tools. That, however, is not conclusive, because it is really comparing the work of one of the best tool builders in England with that which is not our best; and, of course, bad work can be done, whether gears are cut or cast. They maintain, however, that cast teeth are stronger; we maintain that it is an easy matter to make teeth strong enough whether cut or cast. They maintain that they wear better, because the skin is harder; but candor compels me to say that here at Muir's, where I believe cast gears are at least as well made as anywhere, I saw teeth in the same wheel some of which showed a bearing the full length and others not half their length, and this seems to answer the wear and strength argument. This defect is, with us, believed to be inherent to cast teeth, detracting from both wearing qualities and strength. Good results are obtained by good workmanship either way, and, again, it is an illustration of a radical difference in shop practice, with the tendency to change, so far as there is any change, in our direction. Cast gears in machine tools seem to an American to be absurd; here there are many who believe they are best, but many others whose views on this point are changing. Muir's cast gears are, I am convinced, much superior to most cast ones, and are also superior to some cut ones.

A SHOP EQUIPMENT.

Among others I went through a shop building electric motors, dynamos, and the most modern and best types of textile machinery. With very few exceptions, their machine tools seemed to me to be so antiquated and inefficient that if used in an American shop, and in the face of American competition, they would soon bring about bankruptcy. Here I saw lathes having no sliding carriage, but simply a rest which could be clamped at any point on the bed, and then the slide of this rest was fed, when required, by means of a ratchet and pawl and a lever; which lever was worked up and down like a pump handle by a chain attached to a rocking shaft overhead; which shaft got its rocking motion from another chain, coming down to the lathe and attached to a lever worked by a cam on the spindle. The beds of these lathes were very narrow, and where work of any size was to be done the rest entirely overhung the bed in front, and was in some cases braced up by a piece of round iron used as a column and standing upon the floor. In other cases an angle iron had been bolted to the front of the bed to provide a wider base for the rest. Here I saw a Brown & Sharpe milling machine which, I think, had been in the shop some years, and probably no oil or any other lubricant had ever been used for a cut upon it—at least, its appearance was such as to lead me to that conclusion. A man was using it at the time, milling a steel cutter of some kind, dry and with an angular cutter having few unbroken teeth in it; which few were broken just as myself and companion approached the machine; the breakage being chiefly due to the fact that he was feeding the work to the cutter in a manner which no skilled milling-machine man would think of attempting.

Another man was using a Blaisdell lathe of about 20-inch swing. He had a piece of steel in the chuck and was turning it down for an inch or so in length to about 3-16 inch diameter. The work was runing slow, and he was using the compound rest slide, feeding by hand, though the work was parallel. Planers were in use that looked as though they had been "since the Conquest," with great corners broken off the tables by accidents that probably occurred back in prehistoric times. There were a number of more modern tools, both English and American, and the work they were doing was, it seemed to me, excellent. I do not speak of their shop equipment so much in criticism as to call attention to the fact that the men who do the work must be different from ours, and that the conditions of competitive business must be essentially different; for I know that no shop doing the same class of work could live in America, unless it did it with very different equipment. I took pains to inquire of an engineer, who I thought would have opportunity of knowing whether this shop would be considered a good

representative shop here, and he assured me that it would, "with an emphasis on the good."

"HANDY" TOOLS—WORKMEN NOT CONSULTED.

The "American Machinist" of May 6th has just reached me and I have read the description of Bement, Miles & Co.'s large universal boring and milling machine. Among its noteworthy features is the pains that have been taken to provide means so that the man who operates it may always stand as close as possible to the cutting tools and at the same time have at hand the necessary levers, hand-wheels, etc., to control all of the many motions of which the machine is capable without moving from his place. This brings to mind the fact that, generally speaking, not nearly so much pains are taken here to secure this quality of handiness and convenience of operation in heavy tools. The best builders make them plenty strong enough as a matter of course, and put good workmanship into them, but quite frequently all else seems to be overlooked. I saw in an engine shop a large and heavy tool for boring and milling made by one of the best British builders and not long in use. Absolutely no means were provided for moving the spindle saddle in either horizontal direction without walking to one side of the machine, where all the levers, feed-motions, etc., were placed; and when there the operator would in no case be less than 8 feet from the cut and in many cases considerably more. This, it seems to me, is about as bad as it would be to arrange a great organ so that the player would have to turn around and walk about 6 feet from the keyboard every time he needed to look at his music.

I do not mean that all heavy British tools are unhandy and that all American ones are otherwise, but merely that, speaking in a general way and broadly, we pay more attention to such matters and my own personal acquaintance with machine tools enables me to appreciate the importance of them.

The reply of the manager of a large works to a question of mine may throw some light on this matter. I was walking about the shop with him and noticed there was a number of American machine tools along with the English. I asked him how the men liked the American tools and what they thought of them. He said: "Oh! well, we give a man a tool suitable for the work he has to do, and if he don't like it there are others that will." He evidently knew little and cared less about what the men thought of machine tools. This man is successful here as a works manager, but if there is a successful works manager in America who would take that view of this matter, I have certainly never encountered him.

SMITH & COVENTRY—TURRET LATHE PRACTICE—HAND TURNING.

Another tool building concern in Manchester that is very well known and examples of whose work I find in most of the best equipped shops here, is that of Smith & Coventry. It is not an old shop, as shops go in this country, having been founded in 1859, but was one of the first to adopt the present system of shop construction consisting of a central bay lighted from overhead and commanded by a crane, flanked on either side by a floor for smaller machine tools and a gallery. Its shop, built upon this principle, was erected in 1861.

Most of their tools, are, of course, distinctly English, though the influence of American ideas is to be seen in some of their designs—in fact they build a line of brass lathes designated in their catalog as "American," and also some screw machines which are essentially the same as some of those built in America. These they recommend, however, only for small screws and so far as I could learn they have not in the least followed our practice of applying these machines to larger pieces, as we have been doing during the past 10 years more particularly. In fact, my impression, derived from conversation with the younger Mr. Coventry who accompanied me through the shops, is that they prefer for their own work, and recommend to their customers a turret machine having the turret mounted upon the cross-slide of what is essentially a lathe carriage, for all work above, say, ⅜ inch diameter. This turret is not designed to be used centrally, but in front of the work like a tool post, the tools operating like those of the lathe, without special support for the work, and, of course, taking only one chip, for each movement of the turret. The threading die is held in a holder which is hinged to a bar at the back so that it can be swung forward in line with the work when required. I was informed, not only that this machine was the one recommended for such work, but that it commended itself to English shop owners, it being in fact impossible to supply the demand for them at the present time. The strongest point in their favor seemed to be the simplicity and cheapness of the tools required, and this illustrates as well as anything that could be cited perhaps, the essential difference between practice here and practice at home in these lines. We do more and better shop tool work, have more and far better tool rooms in which to do it, and spend money much more freely for tools which are the best we know how to make.

Of course there is a line somewhere between the profitable and the unprofitable outlay for shop tools. The location of this line varies with differing conditions, and conditions are certainly different here from our own, but I have looked into the matter considerably and have seen these machines working in various shops, with the result that I am thoroughly convinced that so long as they continue to make their small parts, screws, etc., as they do now, we shall have decidedly the advantage of them, and the fact that we, with our already long lead, are ourselves rapidly advancing in this respect, makes it look as though we should retain that lead.

The men they have to deal with here are different from ours, and it is more difficult to introduce and really make full use of labor saving machinery and tools, but whatever may be the reason for it, they are making with such machines as I refer to, screws and other parts that we would make on our regular screw machines and in many cases on automatics, at from one-half to one-tenth the cost.

The other day I went through a private locomotive building shop. In their bolt and screw department I saw some of these machines at work. In the same room I saw a man chasing a thread on a bolt about 1⅛ inches diameter by hand chasers. Then he turned down the end of the bolt where it was to project through the nut for about one-half inch with hand tools and rounded off the corner nicely. Water dropped upon the work as he applied his tools to it one after the other, and he finally completed what appeared to be a good job. Naturally, I lingered a little to see this job done, and the young man who was showing me through the works remarked that there was "nothing in that department that was at all extraordinary or out of the usual order," little realizing, I suppose, that I was seeing in the flesh something that seemed to me very much out of the usual order; something I had heard a good deal of and had long been interested in as an ancient tradition of the craft, but had never expected to see—a workshop manipulation and tools, in fact, which formed the subject of part of the address of Mr. John Fritz upon retiring from the office of president of the American Society of Mechanical Engineers, in which he told us of the practice of a supposed by-gone age, and showed the difficulties with which a former generation of machine constructors had to contend.

The fact that this locomotive shop remains in business and is building locomotives for use in Great Britain and a number of foreign countries, some of which I did not before know possessed railroads, and does it in competition with other establishments, would seem to indicate one of two things: either that they are far in advance of us in other respects or, that competition and the art of building locomotives at low cost have not developed to anything like what we find in our country.

Wages, it is true, are lower, the standard rate for men whom in America we would call good machinists, but who are called here "fitters," being 32 shillings per week or about $8. Laborer's wages are not proportionately lower than ours, but boys work very cheaply, and many machines are worked by boys that look scarcely fit to be away from their mothers' arms, and who are dressed in a way that

indicates extreme poverty. Yet in many cases I feel very confident we turn out work similar to that done by them, at lower cost.

TRADES UNIONS AND LABOR SAVING MACHINERY—A GLANCE AT THE FUTURE.

On every hand I hear of the influence of the trades' unions in retarding the use of improved labor-saving machinery here, and there are those who say that it will be difficult, if not impossible, to introduce it generally in what are called here "engineering work-shops," and what we call simply "machine shops," until either the attitude now assumed by the unions is modified or their power is broken. The unions do not, it seems, openly oppose labor-saving machinery as such, but by their demands in relation to it, by attempting to say who shall not and who shall be allowed to operate such machines, what wages they shall receive for doing it and what amount of work they shall do per day, they virtually exclude it from use, because under the conditions imposed, there is no advantage in using it.

I am well satisfied, in my own mind—though I could not, perhaps, give conclusive proof of it—that this influence is at the bottom of a good deal of the criticism of American machinery as being "too light," "too trappy," and "too soon run down." We all know that it is usually an easy matter for men to make a machine work well or ill, according as they may wish it to work; and when I find, and am actually shown, an American machine tool that is virtually a wreck after six or twelve months' use here, and know that machines exactly like it work nearly or quite as many years at home and are still in good order, I, knowing something of shop life and of human nature, am compelled to suspect that there is, in some cases at least, an adverse influence at work. I heard of one machine manufacturer (not an American, however) whose new machinery, placed in a British workshop, continually gave trouble. It broke down; the bearings heated, and there was continuous grief. Being on the ground, and being a practical man, he studied the situation, and, as an experiment, handed the foreman two sovereigns. The machinery worked splendidly from that hour; but the foreman came to grief shortly afterward.

It must not be overlooked that the British workman is, in his own country, "a jolly rum chap"; he takes a different view of life from that taken by our own workmen, and his view of the relation between his employer and himself is radically different. He does not read the "American Machinist," nor is he open to such influence as it and other literature of the art of machine construction exerts. There are exceptions, of course; I am speaking broadly.

It is explained that our labor-saving machinery has been largely put into the bicycle factories here, and has worked well, because that is a new industry, and mostly new men have been put to work in it—men who have few or no preconceived ideas of what amount of work a machine ought to do nor how it ought to do it, but simply operated the machines as they were instructed. Hans Renold, the transmission chain manufacturer, of Manchester, operates his factory on the American system almost completely, and uses American machinery largely. He has studied this problem deeply, and has experimented conscientiously. His conclusion is, that either you must accept things as you find them and run your establishment in the old way, and as the others are run, or that you must discard it entirely, and train your own men in your own way. He has chosen the latter alternative, and has an admirably conducted establishment, of which I shall have more to say at another time. In his shop twenty or more copies of the "American Machinist" are taken; a large proportion for even an American shop, and you find men here who show their achievements with a degree of enthusiastic pride and interest in them that is precisely the same as you find in a good American shop, and totally different from what you find in most shops here. And a noticeable thing is, that the men and Mr. Renold address each other on terms of equality, and there is a noticeable absence of the "sir" at the end of every sentence spoken by the men.

Mr. Rogers, manager of the British Screw Company's works at Leeds, gave corroborative testimony. He came from Providence about six years ago and built this factory which is closely affiliated with, if not controlled by, the American Screw Company, of Providence. He says it is practically impossible to do things in new ways unless you bring up new workmen to do them. In his factory a large number of girls are employed and he showed me a room set apart for them to have their clothing in and provided with wash bowls, hot and cold water and free soap. The clothing hanging upon the hooks looked as different from that seen in similar places at home as the girls themselves did from the girls employed in our factories—both giving one the impression of utter carelessness and absence of pride or ambition. Mr. Rogers said the girls usually stole the soap and omitted the washing.

The men seldom wash in the shops here, and it is not uncommon to see them returning to the shop from meals with the black dirt of a previous shop session on their hands and faces. I do not wish to be ungallant nor unfair, and would not speak of these things at all if I did not consider it necessary in order to get an intelligent grasp of the situation, as it actually exists.

As to the future, it is worth noting that at the present time there is a phenomenal degree of prosperity in manufacturing here, and men who can do anything in the engineering shops are scarce and difficult to obtain. This enables them to have things their own way much more than ordinarily, and many manufacturers put up with what they are convinced is wrong and say little or nothing about it because they fear a strike. In the meantime what is being done in the bicycle factories is having its influence, and when times become less brisk, the owners of the shops may have more to say about what machinery shall be used and how it shall be used. That will be the opportunity for the American machinery builder who can show that his machines will save labor cost, but in that time he will meet keener competition from the British tool builder who will not then as now be six to twelve months behind his orders.

THE QUEEN SEES AN ARMOR PLATE ROLLED.

Yesterday was a great day in Sheffield. The Queen stopped there for two hours on her way to Scotland and was present at the dedication of a new municipal building and saw at the works of Messrs. Cammel & Co., an armor plate rolled.

I stopped a few days in Sheffield and saw something of its steel making and cutlery industries. Incidentally I learned something of how the Queen really saw what purported to be an armor plate rolling operation. Some days before the royal visit the exhibition plate was actually rolled, the works shut down and turned over to the decorators who transformed all that portion to be viewed by royal eyes into a beautiful garden. An archway was cut through the wall so that the royal carriage could be driven directly to a position commanding a view of the rolls and when the time came the plate was warmed up and, handled by workmen attired in special royal blue and white duck uniforms, was passed through the rolls a few times; the Queen looking at it through special "coloured" glasses, that her eyes might not be injured by the glare. And so I suppose the adorable old lady imagines she has seen something of the manufacturing operations that have made Sheffield famous.

The royal visit was, I understand, brought about chiefly by the influence of the Duke of York, who is mayor of the town and has a residence there. A visitor hears a great deal of what the present Duke of York has done and is doing for the city of Sheffield, and he does appear to have been liberal, but I was much more impressed by what the town of Sheffield has done and is doing for the Duke. He seems to own about half of it and more than half of the surrounding country, and its developement, entirely by the work and enterprise of others, brings him in an enormous revenue from ground rents.

Just here is to be found, I think, the influence which, above all others, has operated for generations to bring about the conditions to which I have alluded.

The work people think their employers oppress them and that it is to their interest to do so. They entirely overlook the real source of their difficulties.

Glasgow, May 22. F. J. M.

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Three Samples from the New Navy.

Every machinist feels an almost proprietary interest in the new navy—something additional to that due to his citizenship and growing out of the fact that a modern naval vessel is practically a huge machine and to a very large degree is the product of machinists.

We present herewith illustrations of ships which comprise a part of the new navy, these pictures being reproduced from photographs taken of the vessels as they lay at the Brooklyn Navy Yard, the buildings in the background forming a portion of that immense government establishment.

ARMORED CRUISER—NEW YORK.

This vessel which is considered one of the most creditable ships of the American navy has a total length of 380 feet 6½ inches. Her draft in sea going trim is 24 feet, and her displacement to the load water line is 8,529 tons. A notable feature of her engines is the arrangement for disconnecting one-half of the engine power for use in ordinary cruising—the entire engine power being brought into use only when high speed is desired. The engine has twin screws and there are thus four main engines in all—two to each propeller shaft, with a coupling for disconnecting between. These engines are triple expansion, the H. P. cylinders being 32 inches, the I. P. cylinders 46 inches and the L. P. cylinders 70 inches in diameter, the stroke of all being 42 inches. There are six double ended main boilers having a length of 18 feet, a diameter of 15 feet 9 inches, with eight furnaces to each. The steam pressure carried is 170 pounds, the number of revolutions 135 per minute, and the collective I. H. P. of all engines is 16,950. This vessel, as the flagship of the European Squadron, participated in the representation of the navy at the international demonstration at Kiel in honor of the opening of the Baltic and North Sea Canal. She was there visited three times by the Emperor of Germany, who paid her more attention than any other vessel in the demonstration. About midnight, he, without warning, requested the forward and after engines to be disconnected, which was done in 2 minutes and 46 seconds.

The armament consists of six 8-inch breechloading rifles, twelve 4-inch rapid-fire guns, eight 6-pounder and four 1-pounder rapid-firing guns and four Gatlings in the tops.

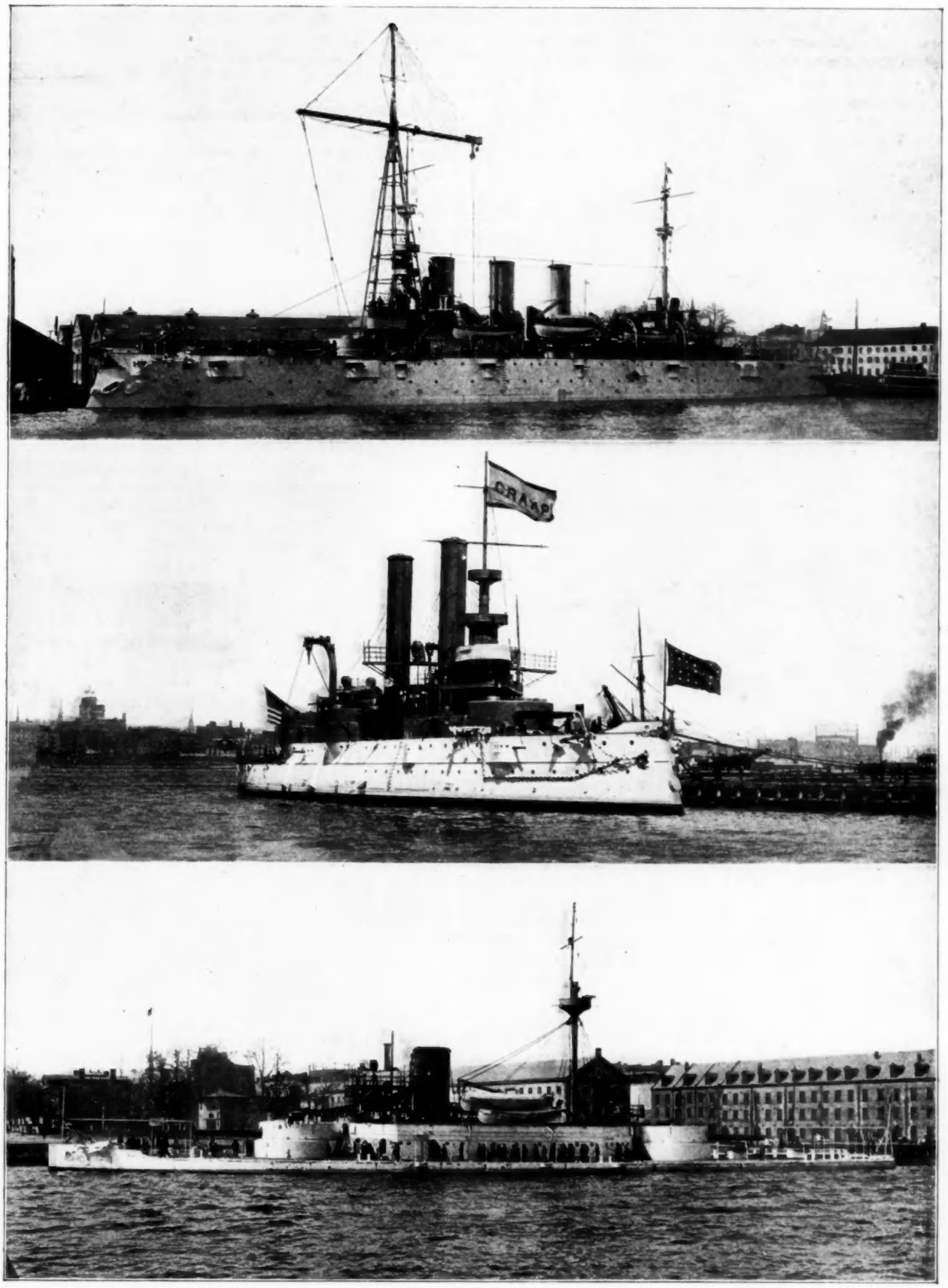
BATTLESHIP—IOWA.

The battleship Iowa is the most recent addition to the navy, the photograph here given having been in fact taken before her acceptance by the government, as will be seen by the fact that the builders' flag still flies at the mast head. Her length on the load water line is 360 feet, the mean draft being 24 feet, and the displacement with full coal supply being about 12,500 tons. Her armament consists of four 12-inch breechloading rifles, mounted in Hichborn barbette turrets; eight 8-inch B. L. R. similarly mounted, six 4-inch B. L. R., and twenty-eight rapid-fire and machine guns. She is twin screw with triple-expansion engines having cylinders 39, 55 and 85 inches diameter with a stroke of 48 inches. There are five main boilers, three double-ended and two single-ended; the lengths of the double-ended being 19 and 21 feet and the single ended 10 feet, the diameter being 16 feet 9 inches for all. Each double-ended boiler has eight furnaces and each single-ended boiler four furnaces. The horse-power upon the acceptance trial was 12,105.

It was the Iowa and the Indiana which were compared so favorably with the corresponding ships of the British Navy by an English naval authority in the "Fortnightly Review." The British ship selected for the comparison was the Renown, which was selected as the finest English ship, though of 3,000 tons greater displacement than the Iowa. The comparison was unfavorable to the Iowa and Indiana in the matter of speed, though the former has since had her official trial, and developed more than a knot in excess of what was then estimated; but, as this writer stated, "In almost every other respect they (the American ships) seem to be immensely, nay, crushingly superior." Thus, in the weight of metal thrown per round, the figures for the Iowa are 5,726 against 2,740 for the Renown; while in muzzle energy of fire, the superiority of the Iowa is nearly two and a half to one for bow and stern fire, and nearly two to one for beam fire, and in coal capacity the Iowa carries 1,775 tons against 800 for the Renown. The writer in the "Fortnightly Review" concludes: "In the war of 1812 we were obliged, much against our will, to take lessons from the United States on the proper way of gunning frigates. We might do worse now than take lessons from the United States on the subject of the proper way of gunning battleships, and also of gunning cruisers, for the American cruisers are as superior to ours as the American battleships are."

DOUBLE-TURRETED MONITOR PURITAN.

The Puritan lately returned to New York after a short cruise to Charleston, S. C., is an iron, double-turreted, low-freeboard monitor of 6,060 tons displacement and 18 feet draft of water. Her construction was commenced at the Delaware River Iron Shipbuilding Yard, at Chester, under the administration of Secretary Robeson, twenty-two years ago. She is 289 feet 6 inches long, 60 feet 1½ inches wide, and 20 feet deep to the top of main deck. While the form and general dimensions of the hull proper, except the armor, remain the same as the original design, numerous and successive changes have been made in every other particular, and many propositions and plans made which were never carried out; the effort of the Department being, during the long, unavoidable delay over her construction, to keep the designs for completion of the ship up to date, and insure that, as finally completed, she should be an effective addition to our naval force. The ship, as originally designed, embodied no radical departure from the "Ericsson" monitors built during the war, except that instead of the single bottom and overhanging armor shelf common to those vessels, she has a double bottom extending up to the armor shelf and nearly the entire length of the hull. The original design contemplated laminated side and turret armor, as no facilities existed then, or for many years after, for producing solid armor plates in this country. The turrets were to have been of the original "Ericsson" type, entirely above the main deck and supported on a central spindle when revolving. Notwithstanding the changes in the hull and fittings, the machinery has been left as originally designed and constructed. Probably from motives of economy, it was not changed except to remove two of the original boilers and supply forced-draft apparatus to those remaining. The machinery is of an obsolete type, and indicates less than three horse-power per ton weight, while ordinary modern practice gives ten horse-power per ton. In every other respect the ship, as finally completed, is fully up to date, and one of our most efficient fighting ships. Notwithstanding the numerous changes, the effect of all of them has been so well considered that when the ship was commissioned on the 10th day of last December, she floated within one-half an inch of her designed draft. She carries a water-line belt of armor 14 inches thick, tapering to 6 inches at the stem and stern. In place of the originally designed armament consisting of but four 15-inch smooth-bore guns, she carries four 12-inch breech-loading rifles in Hichborn barbette turrets, six 4-inch rapid-fire guns, six 6-pounders, two 1-pounders, and two 37-mm. revolving cannon. That the ship is a success in every way is well demonstrated by Captain Bartlett's report from Raleigh, N. C., dated March 8, 1897, from which the following is quoted: "By 6 o'clock it was blowing a fresh northeasterly gale, with a heavy sea, and although the ship behaved admirably, rolling easily and rising buoyantly," etc., etc. "As I have already stated, the ship behaved admirably in the heavy sea off Hatteras. Her roll is not quick, and she recovers easily and without straining. As was to be expected, while pitching very little, she takes great quantities of water on board, the waves dashing violently



U. S. S. NEW YORK, IOWA AND PURITAN.

against the turrets and superstructure and throwing spray over the pilot house and bridges. In my judgment, it would be possible to fight the guns in almost any weather, though not without taking water through the turret ports. In moderate weather she would afford a reasonably steady gun platform, owing to her steadiness and slowness of roll. . . . To-day I inspected the vessel, and, notwithstanding the heavy weather of yesterday, with the exception of slight leaks around the armor shelf, which were in existence when she went into commission, and a very slight leak in the executive officer's state-room, at the base of the superstructure, I could find no defects." This splendid indorsement of the ship's sea-going and fighting qualities fully offsets the unsupported contention of the opponents of the monitor type of vessel, that they are useful only in perfectly smooth water.

The Puritan is fitted with a pair of horizontal direct-acting two-cylinder compound engines, operating twin screws. The screws are fitted with adjustable steel blades and are 15 feet in diameter, with a pitch of 21 feet. The steam cylinders are jacketed and of the following dimensions: H. P. cylinders, diameter 50 inches; L. P. cylinders, diameter 86 inches. The common stroke is 42 inches. There are two air pumps and two circulating pumps, all of the Blake type, and two main condensers of cast iron. There are eight horizontal single-ended return tubular boilers, each 13 feet in diameter and 10 feet in length, with three furnaces in each boiler. The safety valves are set to open at a pressure of 80 pounds. The maximum I. H.P. is 3,700, and the coal-bunker capacity is 314 tons.

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Uncle Sam's Music Halls—Fog Trumpets Run by Compressed Air.

The fogs that gather along the coast at certain periods are extremely dangerous to navigation; so much so, in fact, that a department is established by the Government for the maintenance of a thorough system of fog-signaling in connection with the Lighthouse Department.

New York harbor, the Atlantic coast down to Sandy Hook, and northeast as far as Rhode Island, comprises what is known as the Third Lighthouse District. The department's headquarters are at Tompkinsville, S. I. From this point the government furnishes supplies for the lighthouses and fog signals that dot the coast between the points mentioned. Many improvements have been made during the past few years toward guarding the shipping interests in the perilous times of fog. An indispensable appliance for the safety of a fog-enveloped vessel is a fog horn or trumpet. The department has therefore bent its efforts toward perfecting the system of fog-signaling. Passing from the use of steam, which was deemed inadequate, they have adopted compressed air for making great noises during the fogs. The blast from a first-class compressed-air siren practically bores a hole through the cloud of fog, and reaches vessels that are even many miles away, and warns them that danger lurks there.

To run these compressed-air sirens, an oil engine and an air compressor are used. A plant is now being installed at Montauk Point, L. I., comprising a 10 horsepower Hornsby-Akroyd oil engine and a Class "E" Ingersoll-Sergeant air compressor. The oil engine is best adapted for this service, because steam, the only other available power, would never be ready when wanted. Compressed air can be stored for an indefinite period, and this is a great convenience in case of a sudden fog.

The air compressor cylinder is 10-inch diameter by 8-inch stroke, furnishing 107 cubic feet of free air per minute at 150 revolutions. The air is compressed and delivered to a receiver at 50 pounds pressure. It is then carried to another receiver about 200 feet distant. Midway on the pipe line a reducing valve regulates the pressure and admits it to the second receiver at 30 pounds pressure. Receiver No. 2 holds the immediate supply of air to operate the trumpet. Discharging through the siren at this lower pressure enables the receiver to maintain its supply for a time sufficient to get the engine and compressor in operation. There are two trumpets attached to the receiver, and they are used at once or alternately, as desired. One first-class siren is supposed to consume 12 cubic feet of free air per second. A first-class siren is automatic and blows at intervals of ten seconds. It can be best described by calling it a "good big clarionet."

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A New Way to Feed Boilers.

We illustrate herewith an apparatus for supplying boilers with feed water with a much smaller expenditure of steam for that purpose than is necessary with pumps. Its principle of operation is the filling of an elevated closed chamber with water and its subsequent discharge into the boiler by gravity through the admission of steam pressure upon its surface from the boiler. This steam is then condensed by the next following charge of water so that the heat contained in it is usefully employed in raising the temperature of the feed water. The apparatus is a highly ingenious application of several forces, since pressure, temperature, radiation, condensation and gravity all contribute to its operation.

The following detailed description of the operation of the apparatus is supplied to us by the manufacturers—the Q. & C. Co., of Chicago, Ill., who have had it in operation for the past two years.

The leading essentials of the apparatus are a primary receiever, a main receiver, a differential valve, a steam valve and the requisite check and regulating valves.

Referring to the illustration, it will be seen that the main receiver is placed a little above the boilers and is provided with a steam valve at the top and a relief valve at the bottom, the steam valve being connected with the boiler or some convenient steam line. The relief valve controls the action of the steam valve through a small pipe which connects them.

The primary receiver is located on the floor of the engine or boiler room. If to take hot water from an open heater, it is set sufficiently low to enable it to obtain its supply by gravitation. When steam is admitted through the differential valve, shown in the drawing, the water is forced through the main pipe to the main receiver.

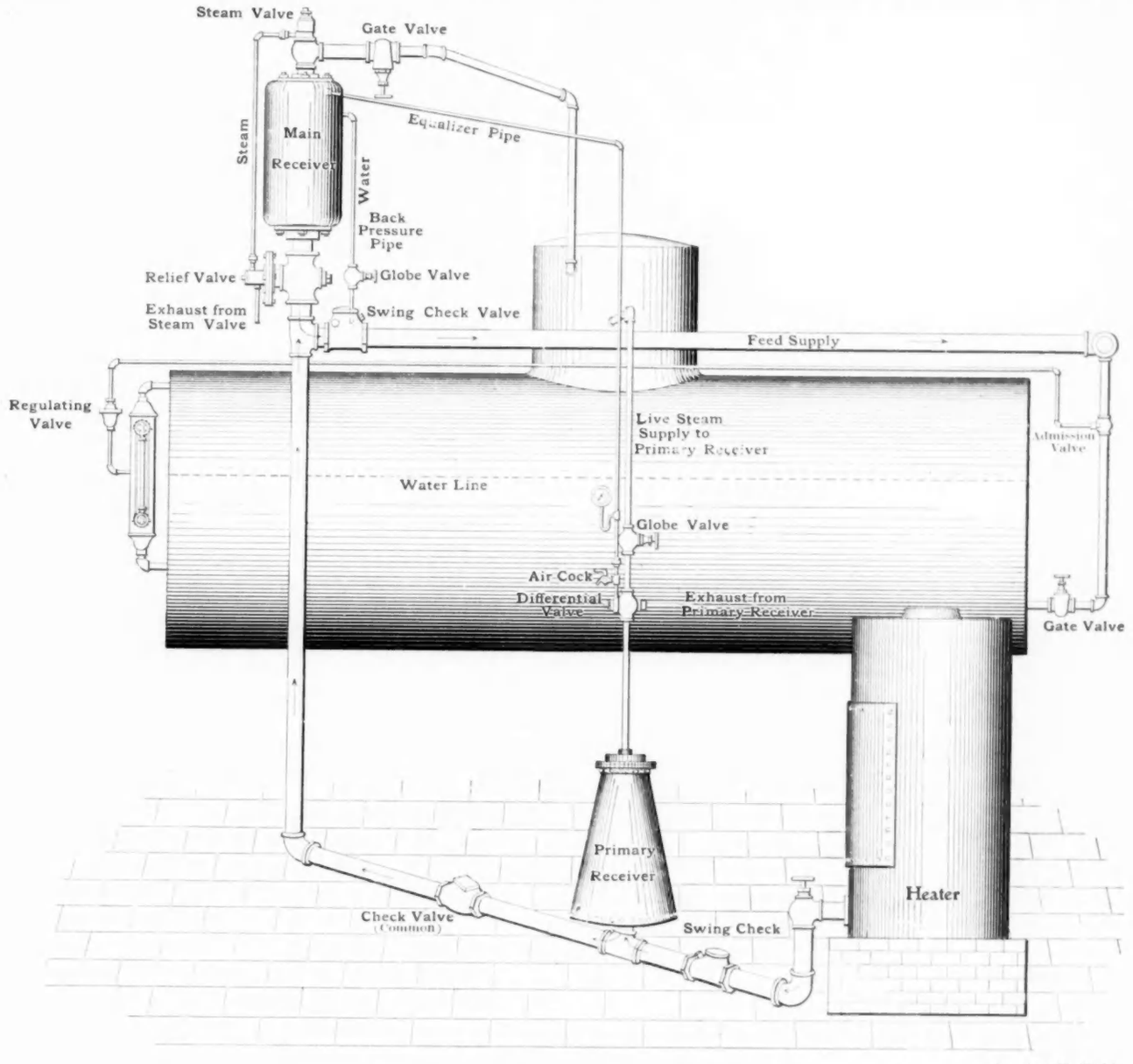
The primary receiver may, however, be arranged to take water from a return tank, or to draw it from a well, and to deliver it into a closed or pressure heater. In this case the main receiver obtains its supply from the heater by displacement. In either case, when the main receiver is filled, the pressure of the water which it contains equalizes the pressure upon the steam valve which then opens and admits live steam to the surface of the water. Thus the boiler pressure upon the check valve in the feed pipe is balanced by a similar pressure above the water, and the hight of the column of water causes it to fall by gravity, until it reaches the water level of the boiler. As the water falls to this level, the relief valve opens communication with the steam valve which closes and prevents further admission of steam to the main receiver. Condensation of the steam confined is begun by radiation, and is accompanied by a slight decrease of pressure.

It will be observed that a small pipe, termed the back pressure pipe, is taken from the check valve on the main feed pipe, between the actual check and the boiler, and is always subject to boiler pressure. But a slight decrease of pressure in the main receiver quickly raises the water, in the back pressure pipe which enters the main receiver as a spray, and instantly causes a great reduction of pressure therein, as the water in the feed pipe is below boiler temperature.

Now, while the main receiver has been discharging its contents, the primary receiver has filled, and is awaiting another admission of steam. This occurs as soon as the reduction of pressure in the main receiver is communicated through the equalizer pipe to the differential valve, which instantly opens and a discharge from the primary to the main receiver follows, condensing the remaining steam and absorbing all the thermal units therein contained. A repetition of these actions makes the operation of the device continuous. The rapidity of the operation, however, varies with the boiler require-

ments without attention from anyone. Though usually arranged to make from two to three discharges per minute, a sudden call upon the boilers will cause the device to double its speed of action, while a lesser requirement will correspondingly retard it.

To regulate automatically the admission of water to each of the units in a battery, so that in each the desired level may be maintained, it is necessary to include some simple attachments which are shown in the illustration. The feed water



THE Q. AND C. SCOTT BOILER FEEDER.

water column, the pipe on which the regulating valve rests being water sealed, as long as the water is fully up to the desired level. At a slight lowering of the water, even by a small fraction of the diameter of the little pipe, the water seal is broken and steam enters the regulating device, which opens the admission valve in the branch feed pipe, thus admitting water to the boiler until the desired level is regained. At this point the regulating connection is again covered by water and the regulating valve closes the admission

As has been shown, there are two uses for steam in this device. In the primary receiver, steam is required to displace the water and to force it up to the main receiver. In the latter, it is employed to balance the pressure on the check valve in the feed pipe, and to follow the water down as it recedes to the level of the water in the boiler; simply to follow the water, not to force it. Such condensations of steam as occur from contact with the water, cannot occasion any thermal loss, as the heats units contained in the steam

is supplied for all the boilers by one pair of receivers, through a main feed pipe with suitable branches leading to each boiler, and an admission valve is placed in each of these branch fed pipes. Each admission valve is connected by a small pipe to a regulating valve which governs it, and which, in turn, is attached by a small pipe, either to the boiler or to the

valve and prevents the further entrance of water to the boiler until evaporation shall again lower the level. With each of the boilers so provided and self governed, it is evident that a practically constant level will be maintained in each, whatever may be its rate of evaporation, and regardless of the relative performance of the other units.

and absorbed by the water are immediately transmitted to the boiler, giving to the feed water a slightly higher temperature, a mere conversion of force.

A certain portion of the heat units in the steam used in the primary receiver is converted into energy to move the water to the elevation of the main receiver, but, as this lift is not much over 10 feet in

ordinary cases, the amount of energy so exerted is small and will be more than compensated by the condensation of the exhaust and retention of heat units at the next influx of water to the primary receiver. And in instances where a spray is inserted into the primary receiver to form a vacuum and to enable the device to draw its supply from a well or cistern, the exhaust is practically all condensed and the heat units are all retained by the water.

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A Continuous Steam-Engine Indicator.*

BY THOMAS GRAY, TERRE HAUTE, IND.

The instrument described in this paper was devised in the spring of 1892 with the object of obtaining a record of the performance of a gas engine during a series of successive cycles of operation. These records were to be used for the determination of the average indicated horse-power of the engine, and also for the study of the character of the successive explosions when the engine was governing, when the relative supply of air and gas was varied, etc. A somewhat crude form of the instrument was at that time constructed, and was successfully used during a number of tests. The great convenience of this kind of indicator not only for the study of gas-engine performance, but for the testing of all kinds of engines under rapidly varying conditions as to load, etc., was at once apparent, and led to the development of the forms of the instrument here described.

The most important feature of this kind of indicator is the mechanism for producing continuous forward motion of the record sheet by means of the backward and forward motion of the piston of the engine. A continuous uniform motion is of course readily obtained, either from one of the revolving shafts of the engine or from an independent source, and for some purposes is sufficient; but where the card is to be used for anything more than illustrative purposes, and even for that, is is desirable that the rate of motion of the paper should, at all parts of the stroke, bear a constant ratio to that of the piston.

A sketch of one form of the instrument which has been found to give satisfactory results is shown in Fig. 1. On the left of the sketch the cylinder of an ordinary indicator with its recording levers will be recognized. The recording pen is shown in contact with a ribbon of paper, *F*, near its lower edge. This ribbon of paper is drawn from a drum *G* (Fig. 2), carried around an idler cylinder at *I*, and wound on a drum *H*. The rate of motion of the paper is controlled by the cylinder *C*, which is driven by the engine in the following manner. The wheel *A* is made to oscillate backwards and forwards through the required arc by means of any of the ordinary reducing-motion arrangements used for taking indicator cards. Cords or metal straps are attached to the upper and lower sides of the wheel *A* and carried in similar directions round the pulleys *B B*, which are fixed to the upper and lower ends of the shaft of the cylinder *C*. The free ends of these cords are then led round the pulleys *D* and connected together through a short spring *E*. If we now suppose the wheel *A* to be turned in such a direction as to pull the cord towards it around the upper pulley *B*, the tension on the cord between the wheel and the upper pulley will be greater than the tension given by the spring *E*, while the tension on the cord between the wheel and the lower pulley will be less than that given by the spring *E*. The cylinder *C* will, in consequence, be given a clockwise rotation, the lower cord slipping round its pulley and acting the part of a strap brake to prevent excessive movement. When the motion of the wheel *A* is reversed the cord between the lower pulley and the wheel has the greater tension, and thus causes the cylinder *C* to turn.

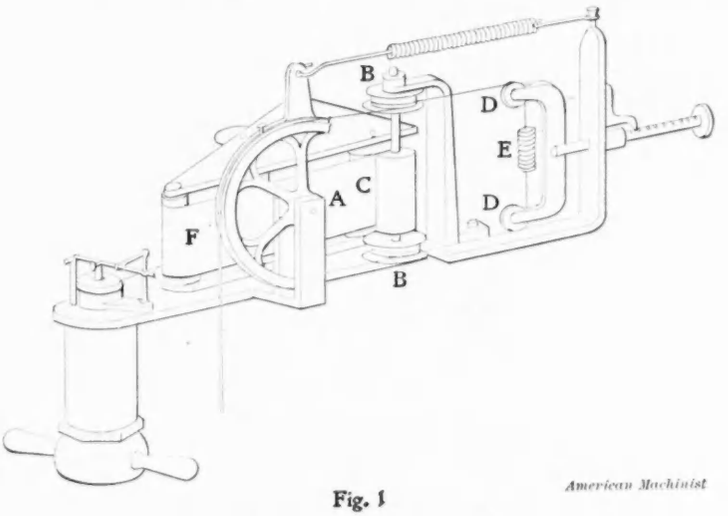

Fig. 1

CONTINUOUS INDICATOR.

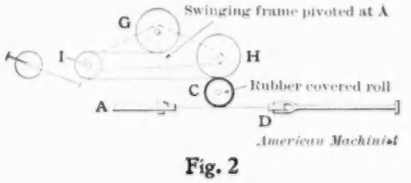

Fig. 2

PAPER ROLLS.

This, however, also gives a clockwise motion to the cylinder *C*, and hence it is clear that both the forward and backward stroke of the engine piston will turn the cylinder *C* in the same direction and at a rate which, at every instant, is proportional to the rate of motion of the piston. The frame which carries the drums *G* and *H* swings round an axis at *I* and is pressed towards the cylinder *C* by a spring. The paper ribbon passes between the drum *H* and the cylinder *C*, and thus when the cylinder is turned the drum is caused to rotate and wind forward the paper. Since the drum *H* is driven through the pressure of *C* on the paper as it comes from the idler *I*, and since *C* turns an equal amount for each stroke, the length of paper which passes the recording pen is also the same for each stroke, no matter how much paper may be stored on the drum.

The resultant turning movement given by the combined action of the upper and lower cords to the cylinder *C* may be expressed as follows. Suppose the upper cord to be pulled, and let the tension on the side nearest the wheel *A* be T, while the tension given by spring *E* is T' and that on the lower cord between *B* and *A* is T'', then we have $\frac{T}{T'} = \frac{T'}{T''} = e^{\mu\theta}$, where *e* is the base of the Naperian system of logarithms, μ the coefficient of friction between the cord and the pulley, and θ the angle of lap of the cord in radius. We thus get a forward movement of

$$M = (T - T')\, r = T\, r\, (e^{\mu\theta} - 1)$$

and a backward movement of

$$M' = (T' - T'')\, r = T''r\, (e^{\mu\theta} - 1),$$

where *r* is the radius of either of the pulleys *B*.

Taking the difference of these two moments, we get for the effective turning motive the expressions

$$M - M' = (T + T'' - 2\,T')\, r = (T - T')\, (e^{\mu\theta} - 1)\, r = T''\, r\, (e^{\mu\theta} - 1)^2.$$

This turning moment is evidently always such as to turn the drum in the same direction whether the upper or the lower side of the wheel *A* recedes from the cylinder *C*. The pull T' should always be sufficient to insure that the cord which has to slide should do so without becoming slack; that is to say, T' should be large enough to prevent any accidental sticking of the cord from causing T'' to become zero.

When, under the circumstances just described, a curve is drawn on the ribbon by means of a pen, the hight of which above a datum line, corresponding to zero pressure, is proportional to the steam

* Presented at the Hartford meeting (May, 1897) of the American Society of Mechanical Engineers.

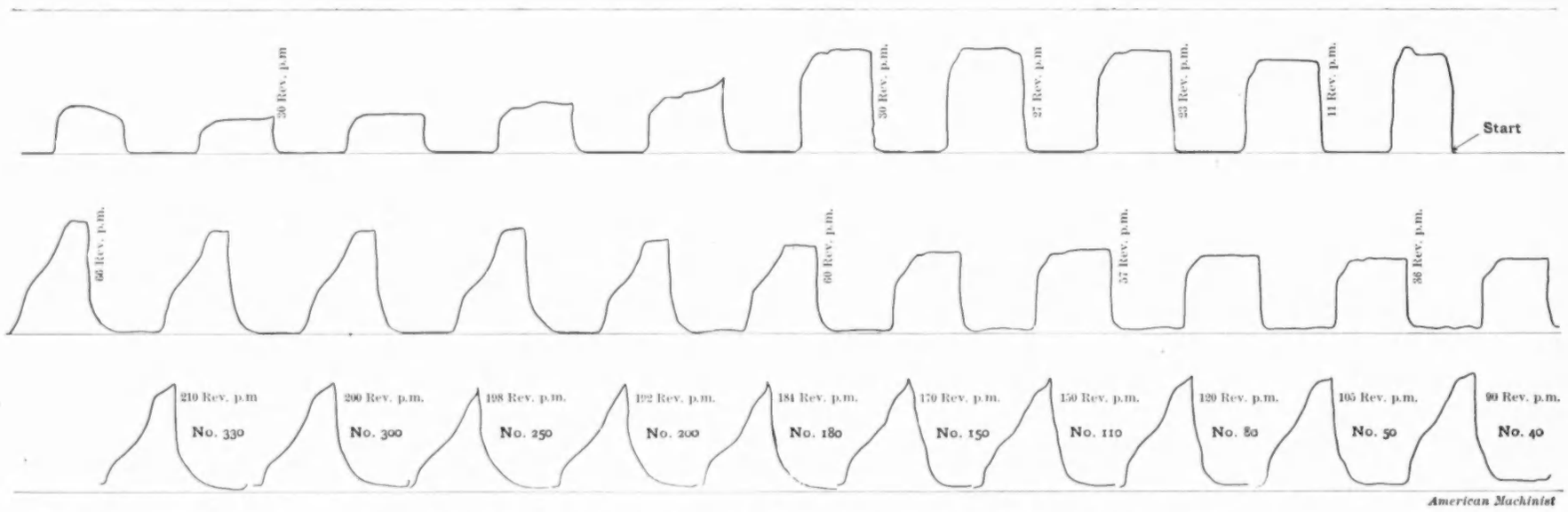

Fig. 5. CARDS SHOWING START FROM REST OF LOCOMOTIVE DRAWING EXPRESS TRAIN.

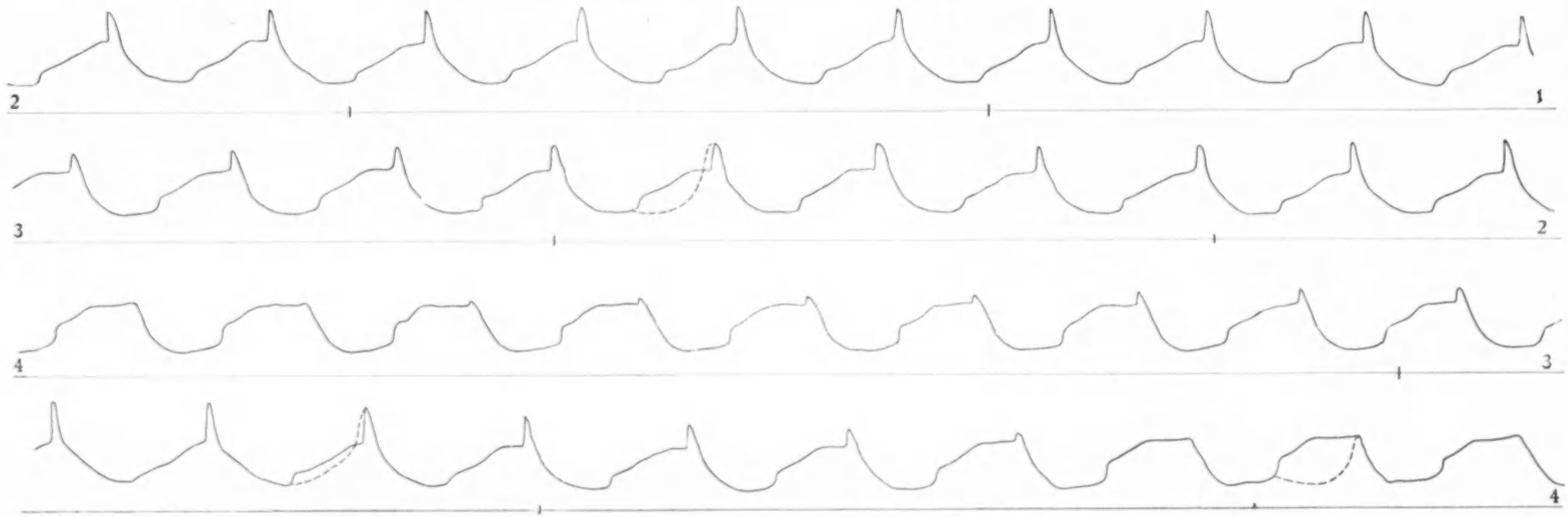

Fig. 6. CARDS SHOWING VARIATION OF LOAD ON AN ENGINE DRIVING STREET RAILWAY PLANT.

or gas pressure on one side of the piston of the engine, the area of the paper included between the datum line and the curve is proportional to the work done on that side of the piston. This work is positive for the forward stroke and negative for the backward stroke. If the indicator piston and piston rod be properly proportioned to suit those of the engine tested, and the ends of the indicator cylinder be connected to the corresponding ends of the engine cylinder, the ordinates of the curve will at all times be proportional to the effective rate of working. For the study of the action of the working fluid, the effects of different setting of valves, of throttling, of varying speeds, and so forth, the most convenient arrangement is to connect one end of the indicator cylinder to one end of the engine cylinder in the ordinary way. The atmospheric line is drawn by a second

Fig. 3

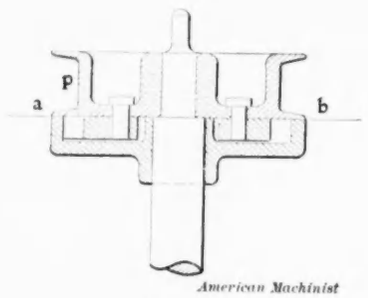

Fig. 4

DETAIL OF CONTINUOUS INDICATOR.

pen (not shown in the sketch), which is made to serve the double purpose of drawing a datum line for the diagram and of marking a time scale on the ribbon. The time scale is obtained by attaching the pen to the armature of a small electromagnet, the coil of which is in circuit with a battery and a break-circuit clock. The clock used marks half seconds, and works satisfactorily even when carried on the front of a locomotive drawing an express train.

The paper ribbon on which the record is taken is usually about two inches broad, and is carried on a light brass drum, *G* (Fig. 2), which is prevented from turning too freely by a light friction brake. The paper is passed over the idler *I* for the purpose of presenting a writing surface in a constant position relatively to the pen levers, and also for the purpose of allowing the drums *G* and *H* to be placed a short distance from the indicator cylinder. This precaution is advisable in order to prevent escaping steam from wetting the pulleys *B* or overheating the cylinder *C*, which is found to work best when covered with rubber. The drums *G* and *H* are interchangeable, and provision is made so that they can be quickly removed and interchanged so as to use the paper more than once if desired. A number of drums is provided so that ample paper is available for a number of tests. Each drum carries upwards of 200 feet of ribbon, and hence, allowing two inches to each stroke of the engine, one roll of paper is capable of taking over 1,000 successive strokes.

The method of feeding the paper ribbon adopted in this instrument, requires the cylinder *C* and the drums to be carefully adjusted so as to prevent the paper from traveling towards one end or other of the drum *H*. When the adjustment is once made, however, the apparatus works perfectly. A somewhat more perfect but much more expensive arrangement is to drive the storage drum by clockwork and a spring, while the paper is passed between the cylinder *C* and a second rolier. The cylinder *C* then simply controls the motion, and is then somewhat more easily driven. Both of these arrangements give cards of equal length, no matter how much paper is on the drum *H*. When quantitative measurements from the cards are not required the paper may be wound directly on to the cylinder *C*. The cards then increase in length as the amount of paper in the cylinder increases, but this is unimportant in such a case, as the change for successive cards is not noticeable.

Another method of driving the cylinder *C* is indicated in Figs. 3 and 4. Fig. 3 is a plan of the part below *ab* in Fig. 4, and Fig. 4 may be taken as a section on *ab* (Fig. 3) of one end of the shaft and driving mechanism of the cylinder *C* (Fig. 1.). In Fig. 4 the driving pulley is shown at *p*. It is in this case loose on this shaft, but carries two pawls, *q q* (Fig. 3). These pawls are pressed by springs against the rim of a shallow cylindrical box which is fixed to the shaft. The pawls are so adjusted that when the pulley turns in one direction (clockwise in the figure), the box, and therefore the cylinder *C*, is turned with it, but when the pulley turns in the opposite direction the pawls simply slip round, while at the same time the cylinder is turned by the pulley on the other end of the shaft. In this arrangement the cords do not slip on the pulleys, but the connection of the pulley to the shaft is such as to slip in one direction and grip in the other. This gives precisely the same action as before, and has the advantage that for the same amount of driving power the frictional resistance is much smaller.

In illustration of the action and application of this indicator two diagrams, Figs. 5 and 6, are here given.

In Fig. 5 is shown a series of cards taken from a locomotive which was drawing the New York and St. Louis express. The engine starts from rest at Greencastle Junction, and attains on an up grade a speed of about forty miles an hour. All the cards are shown until the engine acquires a speed of sixty-six revolutions per minute, after which the cards change very little. Samples of cards, with the number of the revolutions of the engine, reckoned from the start, and the corresponding speed, are given in the last column. From the print here illustrated to the end of the record the speed varied between 210 and 200 revolutions per minute. The engine therefore attained full speed in about 330 revolutions, or in approximately one-mile run.

Fig. 6 is a sample of the results obtained from the high-pressure cylinder of a 250 horse-power Westinghouse compound engine while driving, in parallel with another engine, the Terre Haute street railway plant. A few of the cards have the compression-half dotted back so as to show the work area of the card. The series of cards is continuous, the speed of the engine being approximately 250 revolutions per minute. The cross marks on the datum line show points one second apart in the record. It will be noticed that the engine passes from nearly full load to near zero load in about two seconds at one part of the record. This gives a good illustration of the highly variable condition as to load under which such power plants have to operate. It should be stated that so great and sudden a variation was not again observed, but conditions approaching these are not rare.

To help interpretation of the record, attention may be called to the fact that a loop in the ordinary indicator card forms a forward step in these cards. This is indicated in the cards, which are dotted back in the diagram given.

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A Marine Crank-Shaft Lathe.

The lathe shown herewith is designed for turning marine engine crank shafts of the heaviest class. Although the half-tone brings out the details as well as could be expected, it is much to be regretted that the picture does not also contain a man of average hight, to enable the eye to appreciate the proportions of this admirable tool.

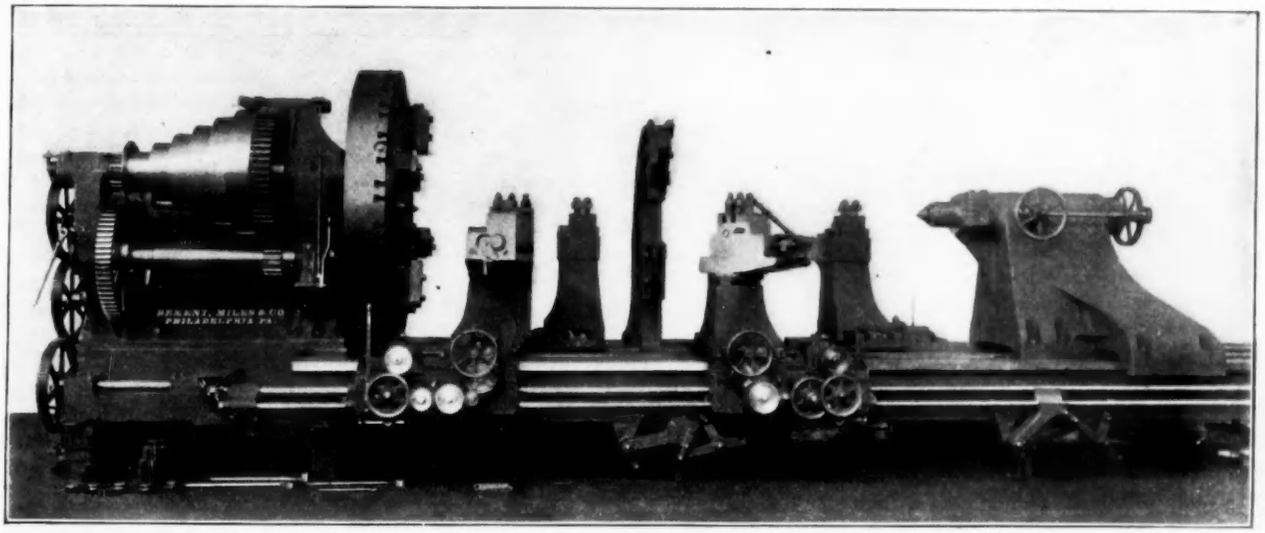
The swing of the lathe is 125 inches over the bed, and 108 inches over the carriage. Several of these lathes have already been built, the last one 40 feet between centers and weighing about 150 tons. The driving cone is 50 inches diameter with 6 steps for 7½-inch belt, giving with the back gears 12 speeds, or with, as is usual, two speeds to the countershaft, 24 speeds in all. A hand friction-brake is attached to the cone to facilitate prompt stoppage The face-plate is 120 inches diameter.

driven internally by a wide faced steel pinion, and provided with four powerful adjustable jaws for chucking work. The main spindle is 20 inches diameter and 10 feet 6 inches long, carried in ample bearings with suitable take-up for wear.

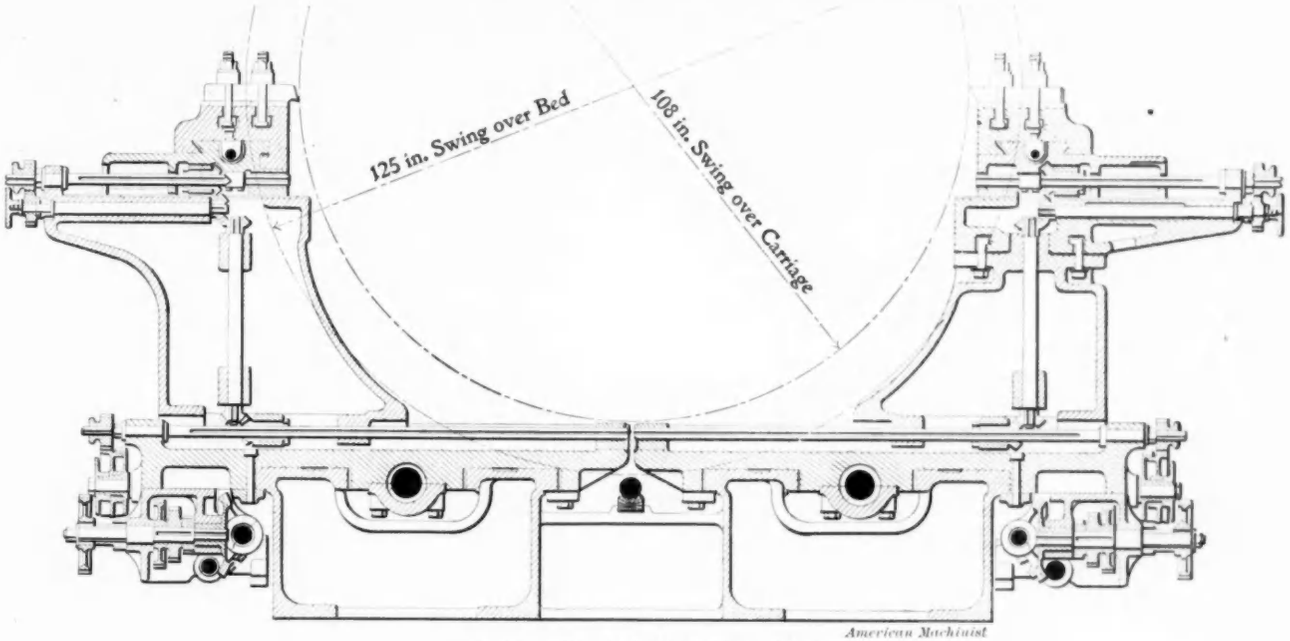
The bed has quadruple flat shears, supporting four carriages, two in front and two on the back, all securely gibbed and each pair made right and left, so that they may work up close to each other. The front carriages, of course, clear the steady rests and also clear the back carriages. Rapid power traverse in either direction is applied to each carriage independently by means of a revolving nut in the carriage running upon a large stationary screw. Ample range of power longitudinal and facing feeds for each carriage is provided, all changes for each being made upon its own apron. Two splined steel shafts supported by several tumbler bearings run along the front of the lathe and two others at the back, for operating these various feeds and movements. The tool posts are made narrow to permit their entrance between the arms of cranks, and have compound slide rests, with power longitudinal and facing feeds, the front tool posts having also swivel heads with power angular feeds. A special narrow tool post is also provided, reaching in to the center.

The foot stock rests on all four shears, is gibbed to each and has rapid power movement by an independent central screw. Its spindle is of steel, 12 inches diameter, 5 feet 3 inches long, with convenient hand adjustment and friction clamp. There are usually three steady rests, each for a different range of diameters, and with three clamping jaws. The half-tone shows the lathe details quite clearly, and the cross section gives the arrangement of the operative devices for the rests. *A A* are the stationary screws for the quick traverse and *B* is the screw for moving the foot stock.

The lathe is built by Bement & Miles, Philadelphia.



125-INCH SWING MARINE CRANK SHAFT LATHE.



CROSS SECTION 125-INCH LATHE.

An Oil Story.

We have before us a complete series of letters addressed to the Fisher Governor Co., Marshalltown, Iowa., by whose kindness we are enabled to reproduce them. The lithographed letter head reads: The Reliance Oil and Grease Co., (Trade mark R in a circle) Animal, Vegetable and Mineral Oils. Sole Manufacturers of Reliance Oils, Lubricants and Compounds. Office, Bratenahl Building, Cleveland, O., U. S. A. Principal Agen-

cies, Boston, Chicago, Pittsburgh, Kansas City, Chattanooga, Omaha. Cable "Oleine," Cleveland, O.

The letters follow:

March 27, 1897.

Fisher Governor Co., Marshalltown, Ia.:

Gentlemen—At a heavy sacrifice we offer you a small shipment of strictly high grade oils now in railway's hands owing to delivery not being made to party in your vicinity who ordered the goods: ½ barrel "Favorite" engine oil, regular price is 25c. here. ½ barrel "Marine" cylinder oil, regular price is 40c. here.

If you will receive at once and save us further expense we will invoice at 19 and 34c. instead. Should you sell the goods for us, will pay agent's commission. Samples by mail free on request. These are the prices before the late advance. It being necessary to immediately dispose of the shipment we kindly request reply at once with order, or refer us to other parties.

Please reply immediately.

Respectfully,

THE RELIANCE OIL & GREASE CO.

POSTAL.

Will you kindly reply to our offer of March 27?

April 14th.—We are in receipt of your esteemed favor of April 12th and note your needs are supplied for the present in the line of oils. We anticipated this when we wrote you quoting the actual cost prices on a small shipment of oil, quality of which we guarantee strictly high grade. We would like very much to have you order the two half barrels for you would be much pleased with the results. Prompt and final disposal of this oil must be made, and we beg to be excused for asking you again to consider the matter, and should you advise us promptly accepting, we will allow you the best agent's discount from the cost prices 19c. and 34c., this being 10 per cent.

POSTAL.

Will you kindly reply to our offer of April 14?

April 28th.—We have yours of April 26th replying to the offer we made of 10 per cent. discount from the cost prices 19c. and 34c. on the two half barrels of high grade lubricating oils, but are somewhat surprised that you do not accept such an offer. We surely do not ask you to accommodate us by taking charge of the small amount of oil without offering you unusual inducements. It is necessary that immediate disposal be made so that expense and further trouble be avoided, and for that reason hope you will pardon us for writing again in regard to the matter. We ask you to consider the matter once more and to take the oil whether you use it yourselves or sell it to some one else. The latter you surely could do at a good profit. Should you write us immediately accepting we will increase the discount from 10 to 15 per cent. We certainly have reason to think you will now accept such an offer.

May 3d.—We have your favor of April 30th replying to the offer made by us of 15 per cent. discount from the actual cost prices on a small quantity of oil, quality of which we guarantee the best. You surely must see an advantage in the prices we quoted on this particular lot of oil which we find necessary to dispose of at once. If you will agree to take it at a discount of 20 per cent., we make you such an offer now and await your reply return mail.

May 7th.—We have your favor of May 5th, it being a reply to the offer we made of 20 per cent. discount from the cost prices previously quoted on the small shipment of oil referred to. We find it necessary now to immediately dispose of this shipment and hope you will kindly accommodate us by receiving the oil, and should you advise us return mail accepting we will increase the discount to 25 per cent. and await your reply.

POSTAL.

Will you kindly reply to our offer of May 7?

▲ ▲ ▲

How the Planer Was Driven.

BY JOHN RANDOL.

There's nothing in the whole round of machine shop vexations more vexatious than the refusal of things that seem sure to fill the bill when seen outside, to do what is expected of them when brought into the shop and set to do work just a little bit different from that they were seen to do so well outside.

One of these contrariwise things has in several instances been found in the electric motor as applied to planer driving, and this use of electro-motive force has had some attention in these pages previously. The present instance, however, seemed like such a sure thing, and proved to be such a sure thing the wrong way, and was finally made right after so much perplexity, that the story is worthy of preservation as being quite likely to save the cost of a year's subscription to some of the readers of the "American Machinist," several times over.

When the history of this planer drive in the Builder's Iron Foundry Machine Shop, Providence, R. I., was told it disclosed other aspects of interest, prior to the electrical experiments, hence the drive of this planer is detailed from first to last.

It is often very convenient to set a large planer across the end of a long shop floor, at right angles to the line shafting, and our American planers, except Sellers' belt naturally that way. This planer is not a Sellers, nor is it American. It is an English planer, by Fairbanks, Kennedy & Naylor, 7 feet by 7 feet, with a 19-foot table and a spiral-geared drive, standing the lathe way if belted direct, with the table travel parallel to its counter shaft. The shop superintendent wanted the planer to stand across the shop, with its countershaft on the wall, out of the way of the crane, as shown in Fig. 1. Because the windows in the partition wall were placed as they are in the picture, the counter could not readily stand higher, nor could it be dropped lower, since as shown it is low enough to have the vertical belting run well. These conditions brought the planer countershaft just nicely clear above the line shaft and at right angles thereto, all as seen at the extreme left side of Fig. 1, the line shaft being carried in wall

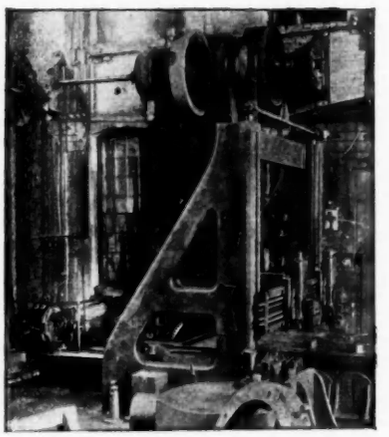


Fig. 1. FINAL ARRANGEMENT OF MOTOR.

brackets to leave the crane space free. This gave an awkward problem in power transmission from the line shaft to the planer countershaft in the beginning, and it stayed awkward for some time. The planer was exactly where it was wanted, and not only where it was wanted, but there was no other good place for it in the shop, and as the shafts were too nearly in the same plane to permit any sort of direct belting, a countershaft was placed on the floor in the corner and driven with a quarter twist belt, and a straight belt was carried from the floor counter to the planer counter shown on the wall.

The planer takes 12 horse-power when cutting, and probably 20 or 30 horse-power when reversing, and the quarter twist belt made a nuisance of itself. No one could tell whether this quarter twist belt was laced with a half-turn in itself, so as to run half the time one side out and half the time the other side out, and so change its long and short sides each time it traveled its own length, as a quarter twist belt always should do, but all the old hands on that floor remembered perfectly that lacing up, patching, and re-

pairing that quarter-twist planer-belt was in order about 300 days in the year, and one fine day the superintendent gave orders for "something else" to the drawing room, and the something else turned out to be a 2-stand rope-drive with turn-shive hung in the top bight of the ropes, and a weighted idler in the bottom bight, all as shown in Fig. 2. Some of the bosses thought it would run and some of them thought it would not. The drawing board artist who designed it wasn't very sure whether it would run or wouldn't run, but thought it would, and so it was tried and did run all right, and drove the planer better than the quarter-twist belt ever drove it, but not without occasional trouble.

The rope was 1⅛ inches diameter, the main-line shive and the countershaft shive had 45-degree angle grooves, and the turn-shives had half-round grooves to fit the rope. The 45-degree grooves were very far away from Scotch practice, but they seem to have performed fairly, and the rope drive stayed, and would probably have been satisfactory, only for the extra pull at the time of reversing the planer table, which has only lately been the subject of such experiments as to show the great increase of power used at the instant of reversal. It is quite probable that this sudden increase of work was what destroyed the original quarter-twist belt drive so rapidly and regularly, and made the trouble with the rope drive.

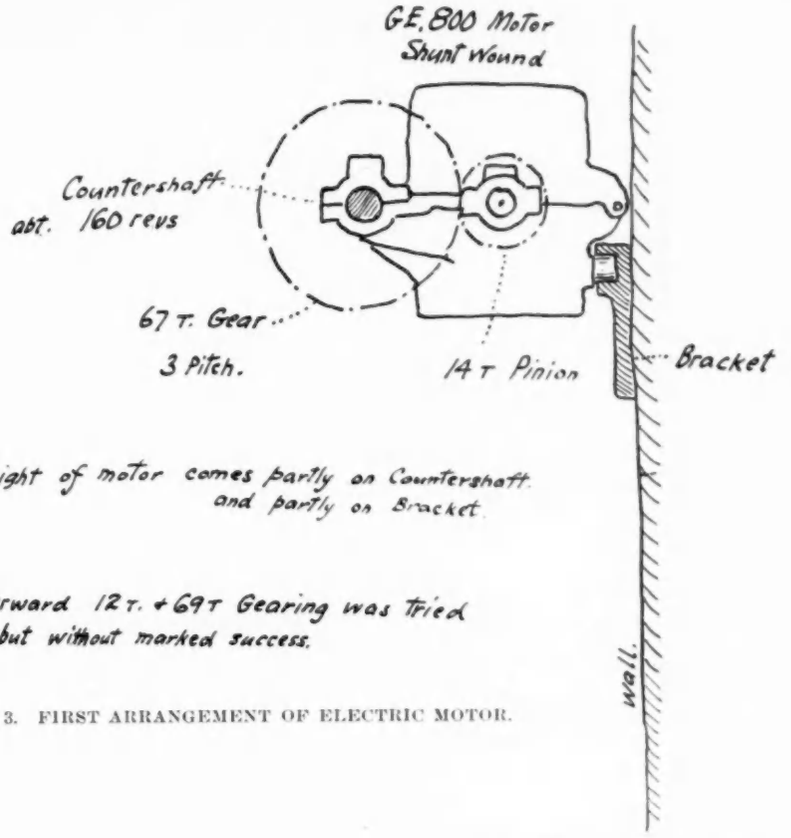


Fig. 3. FIRST ARRANGEMENT OF ELECTRIC MOTOR.

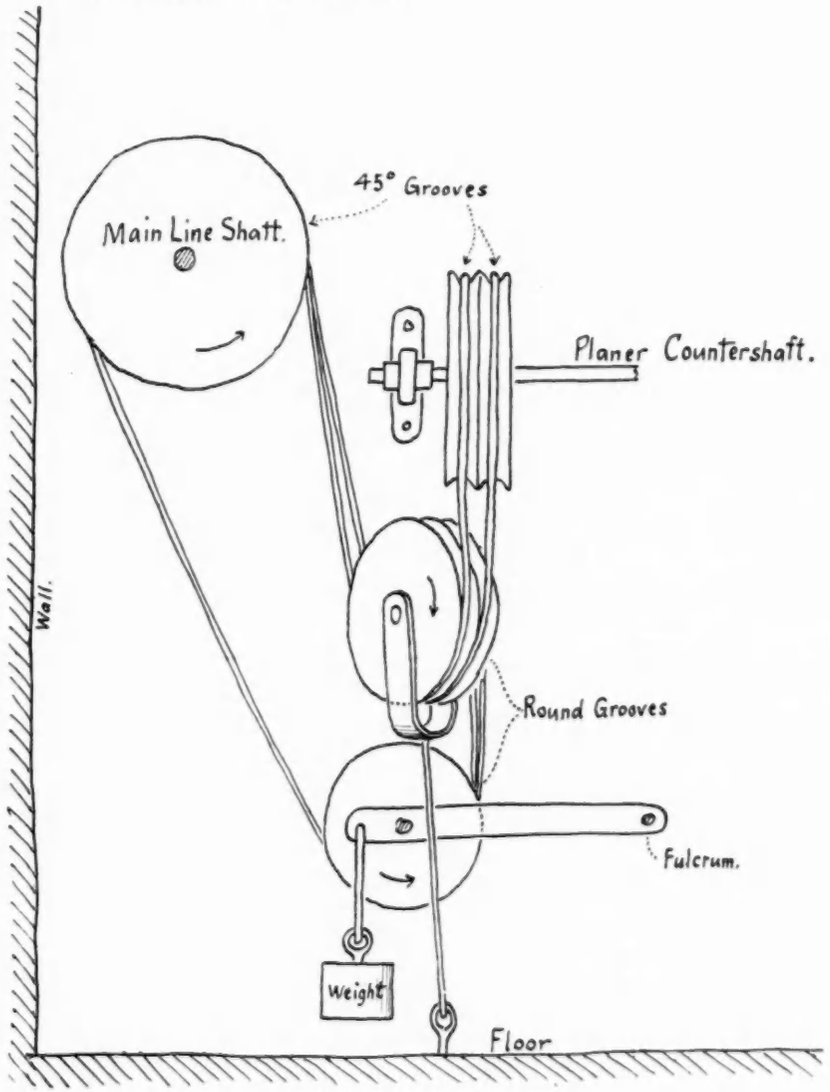


Fig. 2. ARRANGEMENT OF ROPE DRIVE.

Finally somebody saw a 20 horse-power trolley motor and talked about it, and the planer wanted an independent drive, anyway, same as all heavy tools want and should have, and presently the motor was bolted up to the wall on one side and journaled to the countershaft on the other side, as shown in Fig. 3, and trouble began promptly.

The motor ran 650, was shunt-wound, and was geared directly to the countershaft, making 155 revolutions, ratio a little more than 4 to 1, and every time the table reversed the motor burned out. The next step was to install a fly wheel, 48 inches diameter, weight 1,800 pounds, on the countershaft. That helped a little, not very much, and cracks began to come in the brick partition wall. Then the pulleys were changed to make the countershaft run slower, and things were worse than ever because of the loss of fly-wheel efficiency. The motor was up on the wall some of the time for about eight weeks, during which the planer ran about half the time and the motor was in the repair shop the other half of the time, and everybody was pretty mad, and the cracks in the wall became more and more in evidence, and as it was quite evident that if the motor wasn't taken down it would come down itself and bring the wall with it. They took it down and shipped it back

where it was made, and no one was at all pleased with the experiment.

Of course the planer could not be allowed to stand still, and a new 25 horsepower 4-pole motor, special compound-winding, both series and shunt, thus allowing decrease of speed at reversal, the fields being at the same time strengthened by the series winding, was placed on the floor in the corner, and stands there yet, driving the planer in such a satisfactory manner that no one thinks anything about it.

The pulley on the motor is 11 inches diameter, belted with "Leviathan" belting, painted canvas, to a 48-inch pulley on the planer countershaft, which still retains the 1,800-pound fly wheel. The belt was joined with belt-hooks, and has now been in service two years, and is all in good form, except that the belt-hook holes are beginning to tear a little. This shows the belt might have more velocity to advantage.

For the sketches, thanks are due to Mr. Conant, chief draughtsman of the Builder's Iron Foundry, and for this instructive experience itself readers are indebted to the management of the Builder's Iron Foundry, who thus cheerfully disclose their own failures for the benefit of whom it may concern.

The Builder's Iron Foundry is a very old concern, having been in business on the same ground since 1820. It is now managed throughout by young men who fully understand the necessity of doing good work and obtaining living prices therefor, and is in many ways a most interesting establishment, with which the readers of this journal may profitably become better acquainted.

[Not the least interesting feature of this article is the sketches, which are free hand in ink, without pencil preliminaries, and are reproduced as nearly as possible with all the characteristics of the originals. —Ed.]

▲ ▲ ▲

An enterprising night watchman got up an automatic attachment to the electric buttons distributed through the works, so that they would be touched every hour without his tiring himself out in making the rounds. The company discovered the invention, but failed to appreciate it, and then provided the man with a pedometer. The man connected the pedometer with the engine and went to sleep, and when he woke up and reported in the morning it registered 209 miles. The contrivances, of course, challenged the watchman to beat them if he could, but he beat himself out of a job.

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We are entirely out of copies of the "American Machinist," of the following dates in 1897: January 7, 14 and 21; February 18; March 4, 11, 18 and 25, and April 1st.

Letters from Practical Men.

Computing the Strength Per Square Inch of Cast Iron.

Editor American Machinist:

I am pleased to note in your issue of May 13th that the claim made in a former number, March 25th, that the formula given on page 463, "Metallurgy of Cast Iron," for the purpose intended, would give ridiculous results, is greatly modified. I would let the matter rest at this, did you not still seem to think I was ignorant of the principles involved in computing the stress of beams, and say that I thought to advocate a better method for doing that work or to obtain absolute results. To support this claim, you select the following extracts, found at the bottom of page 462: "The author could never perceive wherein the formulas used for figuring the strength per square inch, as advanced by our text-books, etc., had any bearing on the actual area of a test bar and the load at which it broke." After this you say I actually give the strength per square inch of bars by simply dividing the breaking load by the area of the section, and that both my method and results are characterized by the word ridiculous.

To assist in sustaining my position, I will first display a formula or two that are used by some to compute the strength per square inch of cast iron, worked out on the two following tests, for example: One is a bar 1.044 inches square, breaking at a load of 3,428 pounds, and the other, a bar 1.132 inches diameter, breaking at a load of 3,708 pounds. The area of the square bar is 1.0899 and the round bar 1.0064, thus giving the square bar about .08 inch the greater area; but for the purpose of this illustration, it can be said they are practically alike, as far as their forms are concerned in sustaining light loads, as the greater depth of the round bar over the square one, both being practically of the same area, will cause the former to stand a heavier load—upon the principle, if we take a 2-inch x 4-inch plank on its edge, it will stand a greater load than if laid on its flat, end supports being the same distance apart in both cases.

NOTATION AND COMPUTATION OF FIRST FORMULA.

L = Length of beam between supports.
D = Diameter of circular cross-section beam.
B = Side of square cross-section beam.
W = Load at middle of beam in pounds.
F = Intensity of stress at outer fibers in pounds per square inch.

SQUARE SECTION FORMULA.

$$F = \frac{3}{2}\frac{Wl}{b^3} = 54{,}321 \text{ pounds per square inch}$$

ROUND SECTION FORMULA.

$$F = \frac{8}{\pi}\frac{Wl}{d^3} = 78{,}110 \text{ pounds per square inch.}$$

NOTATION AND COMPUTATION OF SECOND FORMULA.

D = Side of square.
P = Breaking load.
W = Load equivalent for 1-inch section.

SQUARE AND ROUND SECTION FORMULA.

$$W = \frac{P}{d^3}\frac{3428}{(1.044)^3} = 3{,}014 \text{ pounds per square inch.}$$

$$\frac{3708}{(1.132)^3} = 2{,}556 \text{ pounds per square inch.}$$

By the above formulas we find the strength per square inch of the square bars to be 54,221 pounds and 3,014 pounds respectively, and for the round bar 78,110 pounds and 2,556 pounds respectively. One formula tells us the square bar is stronger than the round bar by 458 pounds, whereas the other affirms the round bar to be 23,889 pounds stronger than the square bar. It is to be remembered in comparing these results, aside from the question of depth, that there is practically no difference in the areas of the bars and that they are exactly the same length. I could present several formulas which I possess, all varying to such an extent that any expert if taken to court could accept one or the other to make figures lie to give most any results that he might think his client required to gain his case. I cannot conceive of such an array of contradictions and inaccuracy proving that my methods are meaningless or wrong, and that yours are absolute as you would imply.

To show what others think of present formulas and the correctness of my method, I give below recent comments on this subject by Mr. E. D. Estrada, a well-known mechanical engineer of Pittsburgh, Pa.. "These formulas are not absolutely correct in the opinion of several men. In my opinion, they are not even approximately correct. Concerning your method for determining the relative strength of foundry mixtures I will say that as long as you limit it to that purpose and use bars of similar cross section, having the same depth and broken under the same condition that your method is correct."

Your criticisms in both issues imply the idea that I have advanced the formula shown for finding the strength per square inch of any form, length or area of a beam or test bar. Most every chapter treating the subject of testing in my work, refutes such an idea, and teems with the sense implied in the following extract seen on page 521.

"Whatever the size of a common sense bar the testers use, in making comparisons through any range of work, they must stick to that one and then, if they desire to make comparison with outside records that have been obtained with standard bars, other than the one size they use, they would be compelled to make tests with the same size of bars which was used to obtain the outside tests." The

column of strength per square inch in the various tables takes note of any difference that may exist in the area of each respective bar, as it is impossible to cast two bars exactly alike from the same pattern, and when thus reduced to a uniform area, these test records are only utilized for comparative purposes in affirming what are the strength of test bars 12 inches long, cast from the various mixtures of iron shown. There is really only one place in the work that I have deemed it necessary to make distinct comparison of the strength between bars differing radically in their area, as to being affected by the dampness of a green sand mould, and that is found on page 458, which is comparing ½ inch square with 1 inch area bars, and in doing this, I have not computed the ½ inch square bars to strength per square inch, but merely accepted them at the load they broke in making comparison with the larger bars after the manner of a scale to denote degrees in strength. Cast iron differs from steel or other metals, in the fact that a slight difference in section can radically change its physical characteristics. For this reason it is most difficult or impractical to secure the absolute in obtaining the strength per square inch in a cube, from any one size and length of a bar, to be used as a co-efficient in ascribing what may truly exist in some other form, length or area of a casting. I did not accept the formulas shown in my work until after extensive research and study of the subject, as I can prove. If any can offer a better formula for the purpose which mine is presented, I believe all interested in machine construction would join with me in taking pleasure to consider its correctness and value.

This is a subject of vital importance to the engineer, machinist and founder alike. Formulas of the past are certainly ill-suited to cast iron. There is much to be discussed regarding their adaptability that involve the chemical and physical, as well as mathematical consideration to demonstrate lines to be followed in the formation and adoption of any new formulas. As your comments on my methods have forced the issue of question herein raised, I would prefer much to have some outside party take the subject up with me, as I can assure you it is not a pleasant task for me to takes sides with any editor in his own paper.

THOS. D. WEST.

[When the test bars are of uniform cross section and length, the load carried gives all that is needed for purposes of comparison, and the reduction to strength per square inch is uncalled for. When the bars are of different cross section, the reduction to strength per square inch by the method of Mr. West's book can only lead to error, as those methods are fundamentally wrong. The quotation from Mr. Estrada simply endorses the first proposition and expressly limits Mr. West's method to such pieces. No intelligible comparison between pieces of different cross section can be made by Mr. West's method. In other words, in the only case in which it is of any use, it is wrong. We have not advocated the use of any formula as being absolutely correct, but have simply called attention to that of Mr. West as being grotesquely wrong, as it is for all cases in which the reduction which it makes is needed. The two formulas which he compares in this letter, are for entirely different purposes, and the comparison between them proves nothing. One gives the stress upon the outer fiber of a beam, while the other gives the load which a 1-inch beam of the same length as the test piece should carry. No better proof that Mr. West is beyond his depth in this matter is needed than that he should compare the results obtained by these two formulas in order to show their unreliability.—Ed.]

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Nibbling Worm Gears With a Fly Cutter—Elliptic Gears.

Editor American Machinist:

In your issue for May 27th there is a long article, more than two pages, descriptive of a machine for cutting worm gears with a fly cutter, it being taken from an English paper by J. H. Gibson. I like to see honor placed where it belongs, even when it is as small as in this case, and therefore rise to remark that the same idea was patented in the United States by J. A. Nordstedt on November 15, 1887. Undoubtedly Norstedt is still the unhappy possessor of this monopoly, certainly unless he has been persuaded to swap it for a Nebraska farm or some other rubbish, and anyone who may fall in love with the idea can get it cheap. It would be perfectly safe to steal it.

Perhaps the best description of the idea is in your own language: "The machine is then started, and the tool nibbles away." Life is too short on this side of the big pond for any such operation, but the English are an easy going lot and may be willing to wait for that fly cutter to get through nibbling.

Mr. Richards does not seem to feel good over my remarks anent the elliptic gear, at which I am in turn much grieved, for I did not intend to hurt anyone's feelings. I simply wanted to state a fact, but this country is so populous that it is almost impossible to state a fact or anything else without disturbing someone. My experience with the elliptic gear is long, large, expensive and harrowing, and I long since came to the conclusion that it is by all odds the biggest nuisance in the business. If Mr. Richards will set up in the gear cutting business and advertise elliptic gears, he will find that few will accept cheap ones or pay for good ones. I found that the business consisted mostly of making huge estimates that were never again heard from, and if, perchance, I got an order without being called on for an estimate, there was sure to be a "circus" when the bill was rendered. I have a United States patent on a machine for cutting elliptic gears, and will sell it cheap, in fact I would like to swap it for a Nebraska farm.

GEORGE B. GRANT.

Boston, Mass.

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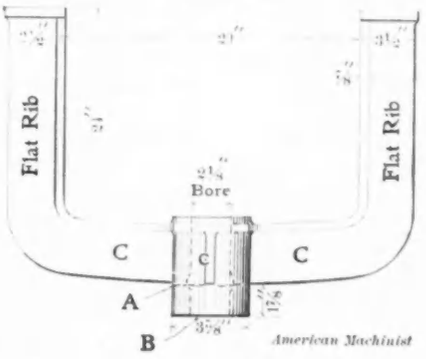
Peculiar Crack in a Casting.

Editor American Machinist:

I removed last night a galled driving shaft from a bearing which showed a curious feature. The boss *B*, shown in the sketch, had a galled groove inside about 1½ inches long and 1-32 inch deep, where the shaft had stuck and cut it. A crack *A* extended all around the outer circumference of the boss as the base of the ribs *C*, but instead of the boss being



PECULIAR CRACK IN CASTING.

ready to drop off without resistance, when struck a few blows, to my surprise the sound rang back clear and true, and on examination the crack was found to be only from ¼ inch to 5-16 inch deep, leaving the surface on the inside at the bearing perfectly sound. The frame is a plain casting with a regular reamed hole through the boss for carrying the end of the shaft. The crack was certainly not there when the casting was originally painted, being open about 1-32 inch and clean and fresh. It only appeared after the bearing was galled, though at no time was it too hot to bear your hand on it. The matter may be of some interest to your readers, as the case is the first I have heard of in 22 years' experience.

WM. HOLLINGSWORTH.

Baltimore, Md.

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A British Invention Anticipated.

Editor American Machinist:

In your issue of May 27th I note a description of a machine for cutting worm gears and would say that some years ago I invented such a machine, and when I desired to get it patented I found I was anticipated by a patent dated November 18, 1887, which patent has since been assigned to me.

As your article may induce some of your readers to make such a machine, I think it proper to let them know that the invention is patented in the United States.

HUGO BILGRAM.

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The Monitor for the American Navy.

Of the three ships of the American Navy shown elsewhere in this issue, the monitor Puritan is far from being the handsomest, or from being calculated to swell the bosom of her commander with pride in her appearance; but she is, in our opinion, by far the most deserving of attention from the American people. We have long believed that the original Ericsson monitor type of ship, developed in accordance with the times, is the one which our Navy needs the most, and about the only one it needs at all. We do not believe that the purpose of the American Navy is to serve the purpose of private yachts for the officers, to carry them about the world for participation in public events abroad, or, on the other hand, to serve the purpose of a chip on the shoulder and all that that implies. Nor do we believe that they perform a function commensurate with their cost, in "showing the flag" to foreign peoples. Washington's farewell advice, that this nation should keep free from foreign entanglements, is just as good to-day as when it was penned, and recent events have proven, if proof were needed, that in the hands of our jingo Congressmen a chip on the shoulder is a dangerous thing to carry.

In our opinion, the monitor type of coast-defence vessel is about the only one for which we have any legitimate use, and the report of Capt. Bartlett upon the good qualities of the Puritan is a splendid vindication of that type of vessel, which effectually demolishes all the pertinent criticisms which the officers of the navy have in the past made upon it. The monitor is the one great American contribution to the art of naval construction. It is an American idea in its entirety, and in the face of its services under past conditions, and its promise under present ones, it would seem as though a proper pride would push it to the front, instead of relegating it to the background, as has been done in the construction of our present Navy. If the truth could be known, we have no doubt that the real reason for this ignoring of the monitor lies in the fact that it is not a success as a sea-going yacht; that it offers little to gratify the eye, from a spectacular standpoint, and especially that the quarters provided for the officers are cramped and uncomfortable, compelling the line to live below decks under conditions approximating those of the engineer officers and other members of the ship's company—in short, that the ship is a fighting machine pure and simple, with every other consideration subordinated to this one. It is for this we believe that the monitor construction has been turned down by gold lace and brass buttons.

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The College Shop.

There is probably no feature of our technical schools on which educators differ so widely as the usefulness and province of the college shop. Among engineers who have been through the shop, there is no such difference of opinion; such men invariably regarding shop training as of the highest importance. Against this, however, may be set the undoubted fact than many graduates have been successful as engineers with very little shop experience.

If the opinions of shop-educated engineers were analyzed correctly, we think that in most cases it would be found that their estimate of the value of their shop training was not based upon the manual skill which it gave them, but on the knowledge of shop methods which they thus obtained, and this we believe points directly to the true purpose of the college shop. It may be set down at once that in many lines of work it is not necessary for an engineer to be a skilled workman; but, on the other hand, that he requires a far wider knowledge of shop methods and of the capabilities and limitations of different methods than does the working mechanic. This is equivalent to saying that while he requires to know how work is done, he need not necessarily know how to do the work, for between these two kinds of knowledge there is a wide difference. In other words, we believe the true purpose of the college shop to be chiefly the teaching of methods. Such manual skill as can be acquired in the process is of course desirable, and will never come amiss in the student's future experience, but it should not be the leading or prime object of the shop work.

If the leading object be, as we have said, the teaching of methods, then our college shops to-day are sadly at fault in ignoring almost completely the most important of all shop methods—those employed in the manufacture of machinery in quantities, which taken collectively we call American methods, and which, if anything will do it, will give supremacy to American manufacturers.

It is certainly an anacronism that American engineering college shops should devote so little attention to instruction in those methods which especially characterize production as it is actually carried on in American shops, but leave the student to "pick up" this knowledge as an incident to future work, and in most cases under circumstances which make it impossible for a comprehensive knowledge to be obtained. The work carried out in the college shops, after the preliminary exercise work is done, is largely the production of individual machines and pieces of apparatus in which these methods play no part. There are, of course, difficulties connected with the actual manufacture upon a large scale of articles for sale, and we do not believe it possible to surround such work with truly commercial conditions, although those conditions may be in a measure approximated, but we cannot see in this any difficulty in the way of effective instruction in the mechanical side of manufacturing methods. The production of many machines has become so systematized that many of their parts can be made in different shops just as well as they can all be made in one shop. Under these circumstances, what is to prevent the making of contracts by the college authorities with manufacturers to supply them with certain individual parts of their product, and then produce these parts on a strictly manufacturing basis? Such a plan would provide work for the school shops of a kind greatly to be desired, and would to a large degree introduce the commercial spirit, while the effects would be far reaching. To begin, the method of production must be schemed and the drawings made, following which the tool work must be done, both drawing and tool work furnishing instruction of a kind now impossible to give, while the fact that the parts themselves must conform

to commercial requirements or be rejected, would introduce some of the spirit into the shop which every working mechanic faces every day as a matter of course. The designing of such fixtures and the making of drawings for them, even in cases where they are simple, would furnish class-room work of very high value, far more so than any possible amount of designing and drawing of machines which are never intended to be executed, and which drawing is in effect mere exercise work. The bare fact that the the work represented by the drawings is to be executed and the drawings subjected to the shop test, would greatly assist in making the students efficient draftsmen, which it is well known, as a rule, they are not. In addition to all this, the parts being paid for would furnish a means of paying students for their work, and so help meet a problem in education which is everywhere present. As matters stand, a student who has served an apprenticeship, and who is a good working mechanic, has very little means of employing his skill to advantage in defraying his expenses. By the method outlined, this difficulty would be in a measure met, and could be made, to a considerable degree, a means of bringing about that most desired end—the giving of bright boys from the shops a chance to secure an engineering education, such lads being, in our opinion, as we have often said before, the best possible timber for the schools to work into the finished product.

The above outline is but one method of using the college shop in strictly engineering work. As a basis of instruction in shop administration and economics, it could be made to serve a very useful purpose.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(91) Z., Stockholm, Sweden, asks if any treatise is published on the subject of drop forgings. A.—We know of no such book.

(92) C. M. W., Bridgeport, Conn., asks for a method of preserving wood. A.—Wood preservative processes are in the hands of corporations, which subject the lumber to treatment when it is in the rough state. We know of no method of treating wood for this purpose after it is in a manufactured condition.

(93) S. S. V., Chicago, Ill., asks: Is there an instrument made for recording the temperature of a lead bath used for heating steel for hardening? A.—In response to this question, Messrs Brown & Sharpe write us: "We know of no reliable method for testing the heat of furnaces for lead baths, although there are several parties who make an apparatus which they claim is successful. We have not found it so in our experience, nor have others with whom we have talked." A representative of the "American Machinist" called at the works of J. H. Williams & Co., Brooklyn, and we were kindly shown their practice. They use the lead bath for heating for hardening and oil for tempering. Expansion pyrometers have been used for ascertaining the proper heat for the lead, but their constant use is not found to be necessary, as the heat of the lead can be judged by its appearance alone. A temperature of about 1,200 degrees is maintained. The tempering is done in a tank of oil, which is heated by oil jets, and a submerged thermometer constantly indicates the temperature. The articles to be tempered are usually small, and are put in wire baskets, a large number at once.

(94) F. H. B., Rock Island, Ill., asks (1) whether compound engines having crank pins at right angles or opposite, give the best results? A.—So far as steam economy goes, there is no difference due to the location of the crank pin, provided the engine is of the receiver type. Engines having the crank pins at right angles are necessarily of the receiver type, while those in which the movement of the pistons is simultaneous are not necessarily so, and formerly were not provided with receivers. The turning moment is more uniform with the cranks at right angles, and this arrangement is, on this account, preferred. 2. How should the slide valves be set? A.—The slide valves of compound engines are set substantially like those of simple engines, except that the low-pressure valve should give a greater lead to the exhaust. 3. Where should the point of cut-off be? A.—The point of cut-off of the high-pressure cylinder depends upon the economy desired. For best economy the cut-off of the low-pressure cylinder should be set at such a point that the volume of this cylinder at cut-off shall equal the volume of the high-pressure cylinder at release. This does not, however, give the quickness of the action to the governor that is desirable for many purposes, and many engines have the cut-off of the low-pressure cylinders connected to the governor to increase the quickness of the governor's action. This is, however, undoubtedly a defect, so far as the strictly correct use of the steam is concerned.

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Personal.

Those of our readers who have been disturbed by the recent note in our columns regarding the health of Prof. John E. Sweet, will be glad to know that a recent communication from him states that he is much better.

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Summer Courses of Study at the Case School of Applied Science.

We have received a copy of the announcement of the summer courses of study in the above institution, which comprise chemistry, mathematics, mechanical engineering and physics. The tuition is $25 for each course, together with a fee of $5 for the use of material.

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Appointments in the Consular Service.

An open letter containing important suggestions upon the above topic has been addressed to the President of the United States by the president of the National Association of Manufacturers. The letter calls attention to the great service that able men in these positions could render in the development of American trade with other nations, and points to the evils of the practice of assigning men to these positions as the rewards for partizan zeal at home. The following suggestions are offered as to such appointments:

1. That the changes in the Consular Service shall be as few as possible.

2. That removals shall be made only because of demonstrated incapacity.

3. That vacancies shall be filled, as far as possible, by promotions or transfers.

4. That appointments shall be made solely upon the basis of proper qualification for the positions, and without regard to political service.

5. That only American citizens shall be appointed to any consular offices.

It is added that just at the present time, when the possibilities of introducing American goods in foreign markets are greater than ever before, the impairment of the efficiency of our consular service by the substitution of untrained men for tried and experienced officials would mean great financial loss to those of our manufacturers who are interested in foreign trade.

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Death of Alvan G. Clark.

In the death of Alvan G. Clark, which occurred at his home, Cambridge, Mass., on June 9th, the world loses at once an eminent astronomer who has individually contributed to the world's knowledge of the greater physical universe, and also a mechanic of unsurpassed skill, whose persevering employment has provided the most efficient means for such investigations. Mr. Clark's father was a painter until forty years old. The beginning of his labors upon astronomical apparatus was in 1843, when a 5-inch reflecting telescope was made from a piece of an old bell. By 1860 the firm of Alvan Clark & Sons had gained a wide reputation for the power and accuracy of their lenses. A telescope was made for the University of Mississippi of 18½ inches aperture, 3½ inches larger than any then existing, and upon the night of its completion the subject of the present sketch discovered the satellite of Sirius through it. The 36-inch lens for the Lick observatory was finished in October, 1887, at a cost of $53,000, Alvan Clark, the father, dying only two months before it was finished. The Yerkes 40-inch lens was finished and placed in position in Chicago only three weeks ago. This magnificent piece of work is valued at $65,000. Mr. Alvan G. Clark was born in Fall River, July 10, 1832, and received only a grammar-school education. As an astronomical observer he discovered fourteen intricate double stars.

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"American machinists are invading England."—"The Engineer," New York. And *The* "American Machinist" is leading the procession.

The Place of Our Destination.—I.

Editor American Machinist:

The above heading is in the plural, because there are two of us; but if I comply with your request there will likely be many things singular in these letters besides the personal pronoun, and if we carry out our desires, the significance of the heading will become apparent.

Descriptions of journeys across the ocean used to be common enough—always interesting to those who have themselves experienced the pleasures or terrors, and never comprehended by those who had not; therefore I would spare you the trouble of reading were it not that it seems as though a comparison between the one just completed and one made just thirty-five years before, may not only be interesting, but in a way instructive. True, this cannot be altogether mechanical literature; but the "American Machinist" must have a large number of young readers whose whole library is found in its pages; to such, at least, a little mixture of travels with tools cannot be wholly trash.

In the early May of 1862 I left Boston in the Cunard steamer America, for Liverpool. She was a wooden side-wheel steamer of, perhaps, 280 feet in length, from 2,000 to 2,500 tons burthen, with what were called side-beam engines—that is, a vertical cylinder with its piston rod connected to a crosshead above, connecting rods or links reaching down each side of the cylinder to the ends of two side levers, and from the other end of the beams a connecting rod reaching up to the drag-link cranks on the shafts; each shaft extending out to its own paddle-wheel. The steamer had been built then about fifteen years, and the company had been in existence some twenty-two years without having lost a passenger, and I well remember that Henry Ward Beecher made the remark that, according to the theory of probabilities, it was quite time one traveled by some other line. The theory of probabilities, like many another theory, seems to have failed, for the company has now been in existence for fifty-seven years, still holding the same record.

The steamer we have just come over in, the Lucania, is a double-screw iron steamer, 620 feet long, 62 feet wide, about 13,000 tons burthen, with two pair of triple-expansion engines of 15,000 horse-power each.

A simple comparison of these figures gives an idea of the growth in size; but the difference in construction and sailing differs quite as much. The two journeys were made in what were called excellent passages, and so far as one can remember thirty-five years back, I think in quite like conditions of the sea. The America had wooden masts, of, perhaps, 20 inches diameter by 100 feet hight, stayed by hemp ropes, and carrying sails which were run up and down continually, as the wind was favorable or the reverse. The Lucania has steel masts 40 or more inches in diameter, 200 feet high, stayed by wire ropes; and they did not haul up a sail during the whole trip.

The side wheels of the America prevented rolling, to some extent; but the ship pitched most unmercifully. In the case of the Lucania, no pitching was perceptible; but she rolled considerably, and worst in a smooth sea, a condition there is certainly no excuse for; for to prevent it is a simple mechanical problem much less intricate than others in the same line.

At the present time passengers are troubled by mal de mer, and have doctors' stuff prescribed as a remedy; in the old time we had sea sickness, and I well remember when my chum suggested a pint of sea water as a remedy. I said I thought a point of land would suit me much better. He seemed to think it very funny; so one can see there has been a change in wit as well as in ships, for what was laughable then seems now as flat as a surface plate.

It is marvelous how well the marine architect condenses space without sacrificing convenience. He gets more in a 7 x 9 stateroom, with room to spare, than a house architect gets in a 14 x 14 bedroom; and in everything about one of the modern ships marvelous improvements have been made. The old ships had companion-ways, which were a compromise between a ladder and a stairway—a feature I have occasion to remember, as I thought it entirely too companionable when I found the number of steps registered on my back when I got to the bottom. Now the stairways are complete and superb.

It was my good fortune to be shown through the engine-room of the Lucania, and a few items cannot but be of interest. Each engine has five cylinders and three cranks. A high and low tandem on the first crank, a single intermediate on the second, and a tandem high and low pressure on the third, the sizes being 37 inches, 79 inches and 98 inches, with a stroke of 5 feet 9 inches, the hight of the engines being 47 feet. The crank shafts are 26 inches in diameter, each in three interchangeable parts, and next comes a thrust bearing piece with twelve or fifteen collars on it, probably 6 inches high and so much of the shafts weigh they say over a hundred tons. The connecting rods weigh ten tons, forged and shaped out of 25 ton ingots, and the rock shaft for simply operating the shifting links, which extend the whole length of the three engines—20 to 25 feet—is 12 inches in diameter. Think of it, the rock shaft, alone as large as the main shaft of a good size steamer. But to me the most marvelous of all were the two main shafts—24 inches in diameter—extending from the thrust bearings to the screws—a hundred and fifty feet or more—extending through tunnels or corridors rather larger than any others in the ship. And these steel shafts, coupled in 27-foot lengths, turned and polished, ran as true as a lathe spindle, in fact I could not detect an imperfection, not a wink, no movement in the bearings, no smoking boxes, no streams of water, no nothing but perfection. The engines make in the trip without stopping from New York to Queenstown, 69 turns a minute and over 558,000 revolutions in all. The pistons travel over 1,200 miles and the surfaces of the thrust bearings over 800 miles, and it would be interesting to know what percentage of the work done by the steam is consumed in friction, before it reaches the screws.

In the early days of screw propulsion, the most difficult thing they had to contend against was the governing of the engines, and during a trip in March, 1865, in the screw steamer City of New York, No. 2, no attempt—or at least no successful attempt—was made to govern the engine, and as the ship pitched fearfully the engines went like a windmill when the screws came out of the water, and slowed down to a quarter speed when wallowing deep in the sea.

Suggestions were then made that the proper source to govern from was wells or chambers in the stern of the ship, and this means is now adopted. So perfect has this system been worked out, that the Lucania is so perfectly governed that in a rough sea she will not race nor lose over two knots out of twenty-two. The principle of the governor is simple. When the stern of the ship comes out of the water the pressure in the chambers is reduced and the throttle closed, when it goes down the pressure is increased and the throttle opened. The preventing of the ship's rolling in a smooth sea is not a more difficult, though different problem. When one stops to think what an insignificant thing a rudder is, and what it does under the worst of conditions, why should he question the efficacy of a rudder in the keel of a vessel to keep it from rolling? As the steersman guides his rudder by the compass, so, too, would the leveler guide his rudder (or fins—as would have to be used in a ship like the Lucania, which has no keel) by a level or plumb.

It might not prove impossible to work the device automatically, but any attempt to hold the ship on an even keel would not do. The ship's natural position when careened by load or wind, would have to be found; or, in other words, the thing desired would be to hold the ship as near as possible at a mean between its natural oscillations. Continuing, I will add that as the ships grow in size, nearly everything else grows, except the size of the men that handle them. A dozen boilers, 18 feet in diameter and 17 feet long, burning 450 tons of coal a day; two smoke stacks, 19 feet inside diameter and 130 feet high; anchors weighing 10 tons, held by cable chains with links made of 3-inch round iron, and iron and steel every-

where possible in the place of wood and hemp—in short, about the only things that remain as of old are the shuffle board and rope rings that everybody tries to throw over a stump of a stick, and succeeds not once in twenty times. It is amusing to see how little it takes to amuse one on shipboard—a puff of smoke, a tip of sail to break the long dead flat line of the horizon, which one always fancies there is land just beyond; a bird, a fish, a porpoise, and perhaps a whale—but when one has gone for three or four days and seen nothing but a piece of sponge or a tuft of seaweed, he will think passing close by a full rigged ship before the wind, one of the prettiest sights he ever saw in all his life.

We made the trip in the America from Boston to Liverpool in rather more than twelve days; in the Lucania from New York to Liverpool in a little over six—doing duty in the dining-saloon three times a day.

JOHN E. SWEET.

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Fair of the American Institute.

We have felt it to be our duty to speak of the recent annual exhibitions of the American Institute, and especially the last, as quite disappointing from a mechanical standpoint. We are assured that a great effort is to be made to have things different at the next fair, to be held in Madison Square Garden, in this city, beginning September 20th and continuing for forty exhibition days. The management earnestly desires that the exhibition of engines and machinery may be the strongest feature of the fair. Ample provision will be made for showing machinery in actual operation. Possible exhibitors should see to it that no failure may be charged to their negligence. The office of the general superintendent, Mr. Alfred Chassaud, is in Madison Square Garden, New York City.

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There is to be a re-union of the students of Friends' School, at Providence, R. I., June 22d. This is the one hundred and thirteenth anniversary in the annals of the institution, and it now recalls its children to its ancient seat, from all parts of the country, to join in the sports of youth, in reminiscences and congratulations.

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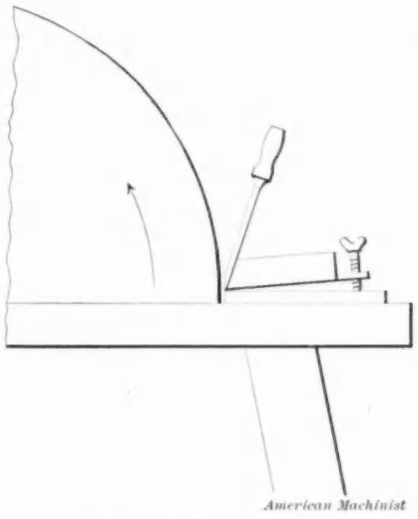
A bill is now pending in Congress, the purpose of which is to make it unlawful for patent solicitors to offer prizes to their clients for patents. An additional clause of the bill provides that the government shall refund fees paid on account of applications which are found to be anticipated by devices already patented. As the search in the United States Patent Office is limited to the office files, the effect of this second provision would practically be the refunding of fees for all rejected applications.

A Simple Patent.

The cut herewith is reproduced from a recent patent. It is probable that little explanation of the invention will be required by our readers. The cut shows part of a grindstone and of the top of a grindstone frame, with a carpenter's chisel and a device, the subject of the patent, by means of which it is assumed that the chisel will be ground correctly. The flat face of the chisel sets against the end of the tilting block, and by means of the thumb-screw the chisel is tipped forward or back-



A SIMPLE PATENT.

ward to bring it to the right angle. Those who have ever ground such a chisel, or seen one ground, and who appreciate the necessity of constantly moving the chisel sidewise across the face of the stone, so that it will wear evenly, can see what an absurd "invention" this is. There is no provision for feeding up the device as the grindstone wears, so that there is here a chance for another patent by some other fellow.

There is, of course, money in this patent—all that the patentee has put in. It might be proper to suggest a different wording for a patent solicitor's advertisement. "Protect *your* ideas; they may bring *me* wealth."

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It is stated that Buffalo, N. Y., is now the greatest railroad center in the United States, having more trackage than either New York, Chicago or St. Louis. Twenty-six great railroad corporations operate their roads through Buffalo. The city had, in 1895, 600 miles of steam railroad trackage, and many miles have been added since. Nearly 4,000 acres of land within the city limits are given up to railroad use.

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A mile in less than two minutes, and the complete circuit of Long Island in 12 hours and 35 minutes, is not bad. The United States torpedo boat Porter did it on June 10th.

Among the bequests in the will of the late Lewis E. Gurley is $8,000 to the Rensselaer Polytechnic Institute, for the purpose of establishing a department of mechanical drawing for young mechanics and apprentices of Troy, N. Y., the tuition to be free.

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We have on hand some second-hand bound volumes of the "American Machinist," one each of the following years: 1882, '83, '84, '85, '86, '87, '88, '89, '90, '91, '92, '93 and '95. We will have these rebound, and send to first order at $3 each, or will sell in present condition at $2 each. We know of no other volumes of these years for sale.

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The motor car seems lately to have got into the disappointing stage of its development. The promises of the recent past are not finding rapid fulfillment. The motor car competition, for prizes amounting to over $5,000, offered by "The Engineer," of London, has been unsuccessful, and the proposed run from London to Birmingham and back, set for June 1st, was abandoned. The judges decided that they could not award a prize to any car exhibited. There were seventy entries, but only seven cars appeared.

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The published photo of the "Turbinia," taken when she was running at a speed greater than ever before attained by any steam-propelled craft, shows about one-tenth of her length forward entirely out of water, while the stern is submerged to the deck. It would seem that it would be profitable for marine designers to make some study of "running balance." It seems certain that if ballast could have been transferred enough to place the hull on a nearly even keel when running a considerably higher speed might have been attained.

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Commercial Review.

NEW YORK, Saturday Evening, June 12.

DYNAMOS AND MOTORS.

As characterizing the past few weeks, we have heard of more noteworthy business from abroad than at home. The London underground railway, which has decided to introduce electricity in the place of steam, has contracted for electrical machinery to the amount of something like a million dollars, to be supplied from this country. Orders to the amount of about one-fourth of that sum have come from Sydney, Australia, in furtherance of a project which will extend to about all the railway lines in the city. Both of these contracts were secured by the General Electric Company.

About here, the electrical business is not especially active. Not a single local office building order for a lighting plant has lately come to our notice. Yet the

potential position of this branch of the market is doubtless still satisfactory.

The Potomac Light & Power Company, Washington, D. C., have been adding some C. & C. machines to their plant, and the new equipment of Wanamaker's store in Philadelphia, the engines for which were referred to last week, will comprise an electrical outfit furnished by the largest of the concerns having offices in this city.

Authorities pronounce the mill power-transmission business as quiet, because factories are not situated favorably for investment. One speaks of it as practically dead, but we hope and believe that its quietude means nothing more than a brief nap.

Mr. H. Mc L. Harding, who has returned from the electric lighting congress, which convened this week at Niagara Falls, speaks of the subject of electrical transmission of water power as one attracting prominent attention there. He believes that although not a great deal is being done in this line of work at the present moment, its prospects are bright.

IN MEXICO AND ELSEWHERE.

Mexican export demand for electrical machinery is said by a close observer of this field to be rather quiet. However, H. B. Coho & Co., who have been making some effort in this direction, see considerable business that may be done in lighting plants. They recently sold a small one for shipment to that country.

At the recent Commercial Congress in Philadelphia, Senor Everardo Hegewisch, delegate from the Chamber of Commerce, of the city of Mexico, suggested that the United States might receive a larger proportion of the trade of that country, which now falls principally to Europeans, if they would adopt the system of giving from six to nine months credits, such as the latter allow. Naturally our manufacturers will feel a reluctance to make concessions of this nature, but the delegate stated that cash transactions are practically unknown in Mexico and that the laws give strong protection to creditors. Another representative from Mexico City is Ignacio Aguirre who, in 1887, established an electrical plant there, with Edison machinery, and is now engaged in the electrical supply business.

The Peruvian Permanent Exhibition of Machinery is to receive a large consignment from the Westinghouse Electric and Manufacturing Company. The trade exhibition idea seems to be epidemic. A commercial museum has been established in Osaka, Japan, which will comprise a section for exports, one for imports, and one for domestic produce and manufactures.

ELECTRICAL RAILWAY ENTERPRISE ABROAD.

Beside those alluded to at the opening of this article, the following electric tramway projects in Europe and elsewhere may be called attention to:

A firm which is constructing an electric railway in Bamberg, Germany, and which works with American patents and American machinery, has contracted to build roads in Liegnitz and Fijme.

R. L. Miller, United States Consul, at Hull, is authority for the statement that there is a movement for the construction and equipment of ten miles of double-track railroad at that place. The overhead electrical system will be used. Everything throughout the work will be of new

(*Continued on page 37.*)

Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Engine Castings ½ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

"Modern Steam Engine Construction," parts 1 to 10; 30 cents each. T. F. Scheffler, Erie, Pa.

Send $1 to the Tabor Mfg. Co., Elizabeth, N. J., for improved stop-motion revolution counter.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Cost of Manufacturing—Experienced manager will establish system of costs, giving exact account of every detail. Charge based on saving effected. Correspondence solicited. Geo. C. Thomas, 99 Nassau Street, New York, Room 212.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

By exp. draftsman and M. E. Box 32, Am. Mach.

Tool maker wants position with mfg. firm; best of reference. Box 53, American Machinist.

Foreman boiler maker wants position; up-to-date hustler; references. Box 52, American Machinist.

Mech. draftsman, 3½ yrs. office, 4 yrs. shop, auto. and general mchy., wants pos. Box 34, Am. Mach.

A good mech. draftsman seeks position; 12 yrs. experience, shop and office. Box 42, Amer. Mach.

A live mechanic wants to travel in the interest of some good specialty; salary or commission. Energy, Box 741, New Haven, Conn.

First class mechanic, 28 years old, capable of taking charge, wishes position city or country; A1 reference. O. Spahr, 231 W. 83d St., N. Y. City.

Foundry foreman wants position; up to date in modern foundry practice; iron and brass; full particulars and references on application. Address Box 51, American Machinist.

A middle-aged mechanical engineer with extensive exp. on light mchy., stamping tools, hardware, registers, bicycles, etc., wants a Western position as supt. or designer. Box 50, American Machinist.

Mech. engineer (age 40) is open for an engagement; 15 years experience as foreman and supt. on fine tools and small interchangeable mchy. Address G. W. N., No. 44 Montgomery Ave., Allegheny, Pa.

Responsible position wanted by an experienced machinist and draftsman, foremanship preferred; have held positions as general foreman for years. Can give best of references. Box 40, Amer. Mach.

Situation wanted by young man; 5 years experience as all-round machinist and 3 years in drawing office; would like to be with a reliable firm and gain more experience. Box 35, Amer. Machinist.

A party with a number of years' exp. in mfg. companies desires a situation as assistant to some mfg. co. Details and management of help pref. Ref. furn. Ad. M. W. C., P. O. Box 1829, Boston, Mass.

Draftsman and machinist, 11 years general exp., desires practical exp. in tool room on jigs, fixtures, special tools, etc.; would draft when desired; salary moderate; references from present employers. Fixtures, Box 14, Parkville, Conn.

Situation wanted as foreman by a first-class man recently in charge of a large die room; thoroughly acquainted with sheet metal drawings in steel and brass; sheet metal fittings for bicycles a specialty; good business refs. Box 48, American Machinist.

A successful mechanical superintendent is open to an engagement; familiar with brass and iron work, interchangeable work, tools, gauges, etc., general machinery and tools, and up-to-date shop and office management. Box 39, American Machinist.

Mechanical engineer (34), energetic, modern; open for service as eng., inventor and constructor; broad experience in constructive work; specialty, mchy. for reducing costs; now with oldest and most successful mfrs. of patented hardware in the U. S.; familiar with costs and methods; no contract less than one year; less than $3,500 per year not accepted. Firms desiring to make success in manufacturing lines will do well to communicate with "Plain Facts," care American Machinist.

Help Wanted.

Wanted—A1 tool maker; subpress hand preferred. Address Box 54, American Machinist.

Machine designer, tech. graduate, 6 years' exp., wants to change. Address Box 3, Am. Machinist.

Wanted—A first-class grinder on reamer, tool and gauge grinding; must be accurate workman. Address Box 47, American Machinist.

Wanted—A young man of good character and ability to take a permanent position in the drafting department of a large manufacturing establishment at a salary of $3 per day. In replying please state experience had, also reference. Box 46, American Machinist.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

For Sale—No. 2 Garvin screw machine, new, with tools. Address Box 56, American Machinist.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Models and experimental work, special machinery, dies, tools, specialties. Welch & Hutchinson, 87-91 Pearl Street, Brooklyn, N. Y.

Patent Office practice, correspondence course of instruction for inventors and draftsmen. Address H. F. Noyes, 56 Liberty Street, New York.

Lathes, planers, drills, milling machines, also brass working machinery; must be modern tools. C. C. Wormer Machinery Co., Detroit, Mich.

Model Locomotives—Complete castings, latest N. Y. Cen. standard, up to date; 4c. in stamps for cat. alog. G. H. Olney, 163 Herkimer St., Brooklyn, N. Y.

Wanted—The address of every young man who wishes to study mechpnical engineering at a low cost. Mech. Dept., Agricultural College, P. O., Mich.

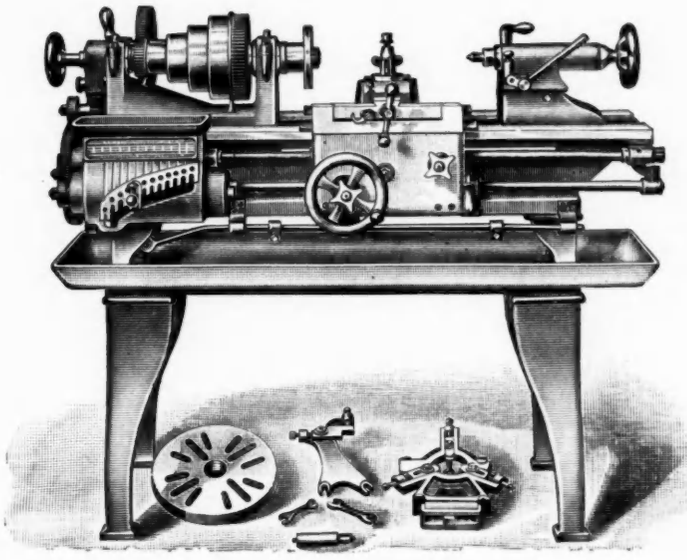
Wanted to manufacture in the South on royalty gasoline engines; one that has passed the experimental stage; give des. Address Box 38, Am. Mach.

Wanted—One 4-foot horizontal hydraulic press, one 4-foot boring mill, one bolt cutter one-half to two inch inclusive, all second hand. Address Box 55, American Machinist.

For Sale—Modern machine shop and foundry in one of the largest cities on the lakes; equipment new and complete; dock and rail facilities; good business; good reasons for selling. Address Box 36, care American Machinist.

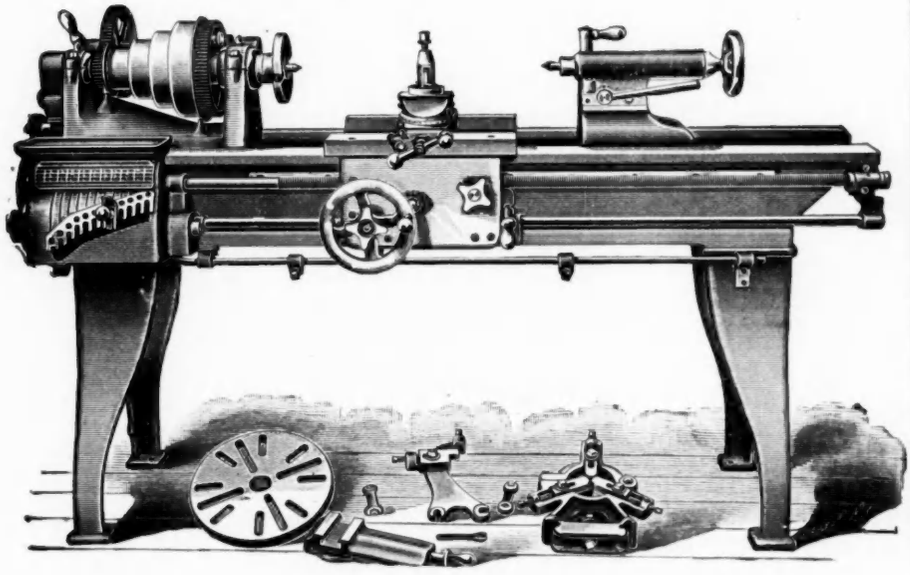
Wanted Capital, $10,000—A one-half interest in an established machine tool company is offered a practical man having the executive ability to conduct the business. Strictly modern shop and equipment with ample orders. Address Box 49, American Machinist.

A machine shop, with modern equipment, heavy and light machinery, cranes of 20 tons capacity and 10,000 square feet of unoccupied floor space, would contract to manufacture any kind of machinery. Parties already having machinery built under contract might do well to write us for estimates. Box 62, American Machinist.



12" Hendey-Norton Lathe

is fitted with drawing-in sleeve and American Watch Tool Co's standard chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterwards. No centering required. See carriage reverse lever by right-hand side of apron; no reaching for countershaft shipper required.



14" x 6' Hendey-Norton Lathe.

These lathes are modern, high-grade, practical tools, and are specially adapted for tool-room work. They have the Norton Attachment for screw cutting, giving 36 different threads and 36 different feeds with only two changes of gear and movement of lever in gear-box from one notch to the other. Note the automatic stop under apron. It will automatically stop carriage at any desired point in either direction; invaluable for internal or duplicate work. SEND FOR CATALOGUE.

The Hendey Machine Company,
Torrington, Conn.

Agents for the Pacific Coast, Pacific Tool & Supply Co., San Francisco, Cal.

European Agents: Chas. Churchill & Co., London and Birmingham, Eng.
Schuchardt & Schutte, Berlin and Vienna.
Eugen Soller, Basel, Switzerland.

(*Continued from page 36.*)

material. The plans and specifications are being drafted by the borough engineer of Hull, and probably they will be submitted to the public for bids in a month or two. Another movement on foot is one to be known as the dock improvement, which is to be undertaken by the North Eastern Railway Company. Some time ago the company purchased the docks of the city, and pledged itself to spend certain monies for the improvement of the docks and the channel of the Humber. The sum to be expended will be not less than $2,500,000, and may reach $4,000,000. The consul suggests that American bids on labor-saving machinery for the purpose be submitted. All communications relative to the electric street railway should be addressed to A. E. White, borough engineer, Hull; while those for the dock improvements should be sent to I. Wolfe Barry, consulting engineer, Hull Dock Improvement, 21 Delabay street, Westminster, London, S. W.

The Edison Company, of Milan, Italy, which has arranged to supply cars and power for the city roads, has, in consequence, increased its capital to $1,800,000.

The roads in Lima, Peru, are to be changed from horse to electric power. The subject will be investigated by Messrs. O. L. Blackwell and R. S. Forbes, who have sailed for that purpose, and will return about July 21st. A railway is to be constructed from Buenos Ayres to Mercedes, but we do not know that electricity will be employed.

ANOTHER GERMAN ORDER FOR AMERICAN MACHINERY.

The German ammunition and small arms factory, at Berlin, has given an order to the Cleveland Machine Screw Company, of Cleveland, Ohio, for nearly $120,000 worth of machines for making steel balls for bicycles. This article used to be made almost exclusively at Schweinfurt, Germany, and was exported to the United States in small quantities. The value of these exports for the last four quarters amounted to $20,877. Previous to this the manufacturers at Schweinfurt had been considered as having a sort of monopoly, it being thought that they were the sole possessors of patents for the manufacture of such balls, and it came in the nature of a surprise when it was found that not only were they being manufactured in the United States, but that we were shipping them to Germany. The phenomenal development of this steel ball industry is shown by the fact that an English syndicate offered one million of dollars for a Schweinfurt factory engaged in this line of work, which was made a joint stock company twelve months ago with a capital of only $150,000. After the first year's work was over, the balance sheet showed a net profit of about $87,000. Commercial Agent Stein, located at Bamberg, says that quite a number of steel ball

factories have sprung up in his district during the last few months; one of them situated in Bamberg. Some of them have only been partially started, for the reason that it has been impossible to procure the necessary machinery, since the German works are engaged for many months ahead.

AN OPPORTUNITY TO SELL AMERICAN DREDGING MACHINERY.

A report received at the State Department tells of a canal that is to be built by Russia in order to connect the Baltic with the Black Sea. The canal, as projected, will connect Riga, on the Baltic, with Chersen, on the Dneiper, near the Black Sea. It is to be 1,000 miles long, 65 meters wide at the surface and 35 meters at the base, with a depth of 8.5 meters. The cost of this canal is estimated to be $100,000,000. Undoubtedly it will cost more than this amount. It is to be ready for traffic in five years. The United States should be able to secure a fair proportion of the contracts for dredging and canal machinery, if she can compete with German prices.

Quotations.

NEW YORK, Monday, June 14.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 00 @ $12 50
No. 2 foundry, Northern	11 00 @ 11 25
No. 2 plain, Northern	10 50 @ 11 00
Gray forge, Northern	9 75 @ 10 25
No. 1 foundry, Southern	10 25 @ 10 75
No. 2 foundry, Southern	9 75 @ 10 00
No. 3 foundry, Southern	9 50 @ 10 00
No. 1 soft, Southern	10 25 @ 10 50
No. 2 soft, Southern	9 75 @ 10 00
Foundry forge, or No. 4 Southern	9 25 @ 9 50

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.05c.; refined, 1.10 @ 1.25c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.35 @ 1.45c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store in small lots, 1.50c.

Cold Rolled Steel Shafting—Base size, 2.40c., in small lots, from store.

Copper—Carload lots, Lake Superior ingot, 11c.; electrolytic, 10⅝ @ 10¾c.; casting copper, 10⅜ @ 10⅝c.

Pig Lead—In carload lots, 3.25c., f. o. b., New York.

Pig Tin—For 5 and 10-ton lots, 13.85 @ 13.90c., f. o. b.

Spelter—In carload lots, New York delivery, 4.25 @ 4.35c., f. o. b.

Antimony—6¾ @ 7¼c., according to brand.

Lard Oil—Prime city, present make, commercial quality, in wholesale lots, 35 @ 37c.

▲ ▲ ▲

Manufactures.

At Enterprise, Kan., J. B. Ehrsam & Sons are erecting a foundry.

Franz Reinhart, of Haledon, N. J., is making an addition to his mill.

At Warren, Mass., the Slater Engine Company has been organized.

The mill of William Engel & Co., Orono, Me., will have an addition erected.

C. A. Thomas, Roanoke, Va., contemplates the installation of new machinery.

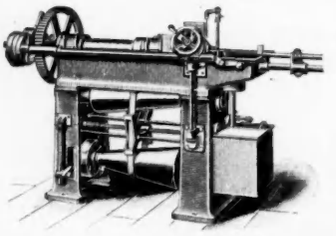
At Albion, Pa., it is expected that the P. B. & L. E. Company will erect machine shops.

The Roane Iron Company, of Rockwood, Tenn., is making improvements to its plant.

The Standard Boiler & Bridge Company, of Bellaire, O., intend to erect a new building.

The Montmorency Cotton Company, of Montreal, Can., will erect a mill at Drummondsville.

CUTTING-OFF LATHES



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